montanore

Final Environmental Impact Statement

Noranda Minerals Corp.
Montana Reserves Company
Joint Venture

MONTANORE PROJECT

PREPARED BY:

U.S. Forest Service

Montana Department of State Lands

Montana Department of Health and Environmental Sciences

Montana Department of Natural Resources and Conservation

Final
Environmental Impact Statement

NORANDA MINERALS CORPORATION
MONTANA RESERVES COMPANY
JOINT VENTURE

MONTANORE PROJECT

OCTOBER, 1992

U. S. Forest Service
Kootenai National Forest

Robert L. Schrenk

Robert L. Schrenk, Forest Supervisor

Montana
Department of State Lands

Dennis D. Casey

Dennis D. Casey, Commissioner

Montana Department of
Natural Resources and Conservation

Karen Barclay Fagg

Karen Barclay Fagg, Director

Montana Department of
Health and Environmental Sciences

Dennis Iverson

Dennis Iverson, Director

COVER SHEET

Type of Statement

Final Environmental Impact Statement

Proposed Action

Construction and operation of the Montanore Project

Lead Agencies

Kootenai National Forest
Montana Department of State Lands
Montana Department of Natural Resources and Conservation
Montana Department of Health and Environmental Sciences

Cooperating Agencies

Montana Hard Rock Mining Impact Board
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Bonneville Power Administration

Abstract

The Montanore Project Final Environmental Impact Statement describes the land, the people and the resources potentially affected by the proposed Montanore Project. The major federal and state action consists of the approval of all necessary permits to construct and operate the Montanore Project. The proposed project would consist of six primary components: an underground mine, a mill, two adits and portals, a tailings impoundment, access roads, and a 16.7-mile electric transmission line. Nine alternatives analyzed in detail in this Final EIS include the proposed action, modifications to Noranda's mine proposal, three alternatives which include modifications to Noranda's mine proposal and modified water management/treatment, modified Miller Creek alternative transmission line routing, North Miller Creek alternative transmission line routing, Swamp Creek alternative transmission line routing, and no action.

For further information, please contact

Richard Stearns
U.S. Forest Service
Kootenai National Forest
506 Highway 2 West
Libby, MT 59923

Alicia Stickney
Montana Department of State Lands
Capitol Station
Helena, MT 59620

Kevin Hart
Montana Department of Natural Resources and Conservation
1520 East 6th Ave
Helena, MT 59620

Abe Horpestad
Montana Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620

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SUMMARY

THIS document summarizes the information contained in the Final Environmental Impact Statement (Final EIS) for the proposed Montanore Project. As a summary, this document cannot provide all the detailed information contained in the Final EIS. If one is interested in more detailed information, the Final EIS should be reviewed. It can be obtained by contacting one of the following people—

Richard Stearns
Kootenai National Forest
506 Highway 2 West
Libby, MT 59923

Alicia Stickney
Montana Department of State Lands
Capitol Station
Helena, MT 59620

Kevin Hart
Montana Department of Natural Resources and Conservation
1520 East 6th Ave
Helena, MT 59620

Abe Horpestad
Montana Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620

A copy of the EIS can be reviewed at the following locations—

Northern Regional Office, U.S. Forest Service, Missoula, MT

Supervisor's Office, Kootenai National Forest, Libby, MT

Cabinet Ranger Station, Trout Creek, MT

Libby Ranger Station, Libby, MT

Montana Department of State Lands, Helena, MT

Montana Department of Health and Environmental Sciences, Helena, MT

Montana Department of Natural Resources and Conservation, Helena, MT

Lincoln County Library, Libby, MT

Missoula City-County Library, Missoula, MT

THE EIS AND PERMITTING PROCESS FOR THE MONTANORE PROJECT

The "Montanore Project" is a proposed underground copper and silver mine in northwestern Montana. The project is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. Noranda would be the operator. The mine would be in Sanders County, and the mill and other facilities would be located in Lincoln County, about 18 miles south of Libby, Montana (Figure S-1). Noranda currently holds mineral rights within the Cabinet Mountain Wilderness. The purpose of the proposed action is to develop these interests with the Montanore Project. The project would include constructing a mill for ore processing and associated mine waste disposal facilities. The proposed project also would require constructing about 16 miles of high voltage electric transmission line to the project site.

Procedures governing the EIS analysis process in Montana are defined in administrative rules implementing the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA), and the Montana Major Facility Siting Act (MFSA). These laws require that if any action taken by the State of Montana or the U.S. Forest Service may "significantly affect the quality of the human environment," an EIS must be prepared. The Final EIS was written to meet the requirements of these statutes and the administrative rules and regulations implementing these laws adopted by participating state or federal agencies.

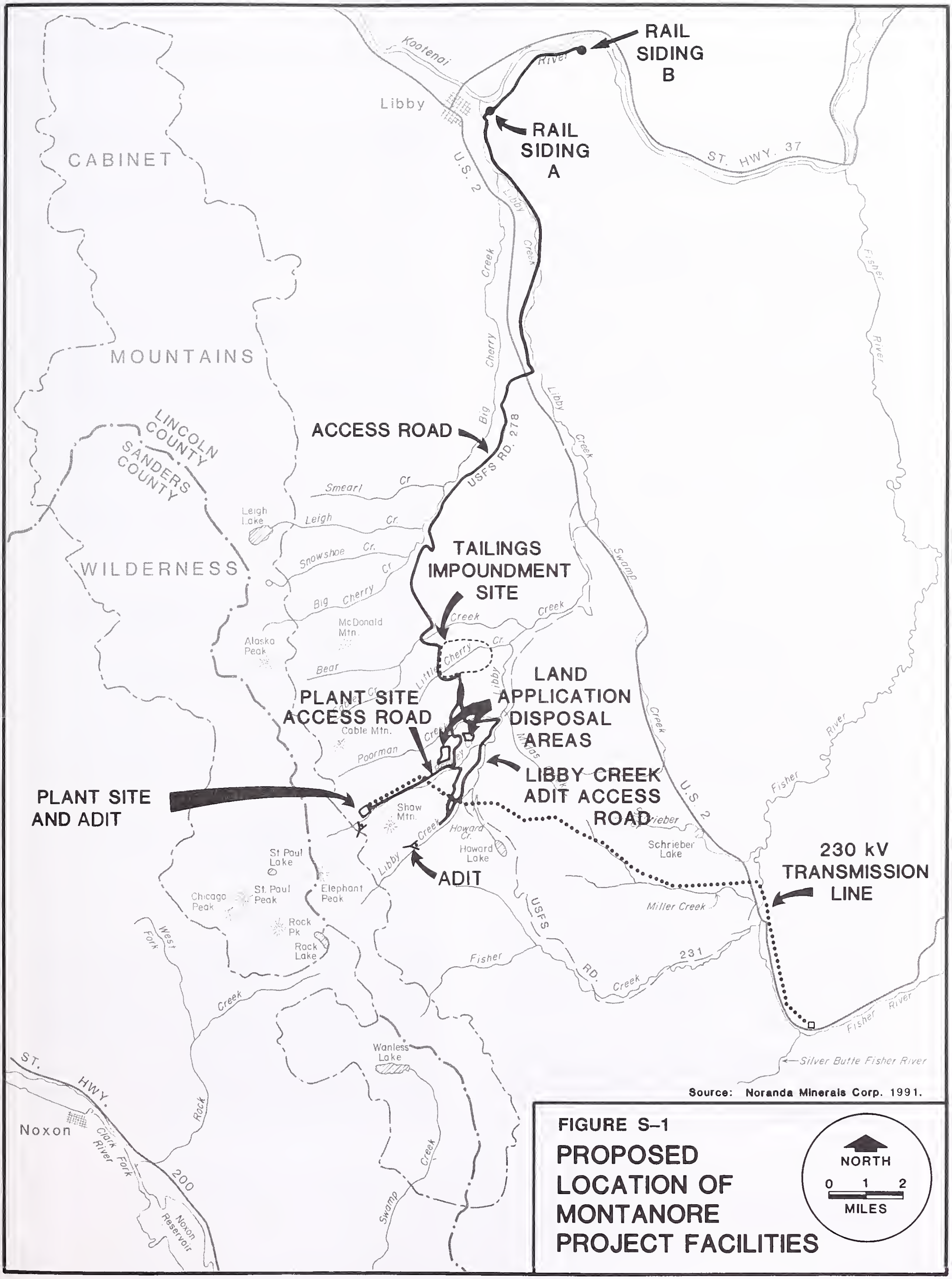
Four governmental agencies serve as "lead" agencies for this EIS. The environmental analysis documented in the Final EIS was initiated in response to applications to operate the Montanore Project submitted to the Montana Department of State Lands (DSL), the Kootenai National Forest (KNF), and the Montana Department of Natural Resources and Conservation (DNRC). The Montana Department of Health and Environmental Sciences (DHES) is also a lead agency in response to Noranda's petition for Change in Ambient Water Quality.

The scope of the Final EIS includes actions, alternatives, and analysis that would be considered in separate EISs required by each agency in order to fulfill their regulatory responsibilities. Preparation of a single Final EIS for the Montanore Project provides a more coordinated and comprehensive analysis of potential environmental impacts. The decision to be made by each agency is to grant or deny the necessary permits or approvals for Noranda to operate the Montanore Project. Permitting decisions will be based on the environmental effects and consequences as documented in this Final EIS, along with other information presented during agency decision-making processes, to determine what conditions are necessary should the project be approved.

DEVELOPMENT OF ALTERNATIVES

Under MEPA, NEPA, and MFSA regulations, the agencies are required to consider the environmental effects of a proposed action and of reasonable alternatives to that action. Two alternatives which must be considered in the Final EIS are the "proposed action" alternative—construction, operation and reclamation of the Montanore Project as proposed by Noranda—and the "no action" alternative, or denial of permits and approvals.

Public participation has been sought and encouraged during preparation of the EIS. The first opportunity for public involvement occurred very early in the EIS process when "scoping" was conducted. During scoping, a list of environmental issues related to the proposed action was developed based on public comments and agencies' analysis. The development of alternatives and assessment of impacts focused on the significant environmental issues. A public meeting was held in Libby on August 9, 1989 to record concerns of people interested in Noranda's Montanore Project. A number of written comments were also received during the scoping period.



Source: Noranda Minerals Corp. 1991.

FIGURE S-1
PROPOSED LOCATION OF MONTANORE PROJECT FACILITIES

Another meeting was held on February 15, 1990 to discuss Noranda's petition to the Board of Health and Environmental Sciences to change the quality of ambient water.

On October 10, 1990, the agencies released a Draft Environmental Impact Statement (DEIS) for the Montanore Project for public review and comment. A public meeting was held on October 24, 1990 to explain the contents of the DEIS and gather public comment on the agencies' analysis. The lead agencies decided to prepare a Supplemental DEIS after reviewing public and agency comments submitted on the DEIS. The agencies issued the Supplement on November 8, 1991 for public comment. A public meeting and open house was held on December 9, 1991 to solicit public comment on the supplement. Following a review of the public comments on the Supplemental DEIS, the agencies decided to proceed with issuing this Final EIS. This FEIS integrates the analysis documented in the Supplemental DEIS with that contained in the DEIS. Aspects of the analysis contained in either the DEIS or the Supplemental DEIS have been modified to reflect comments received from the public. The analysis documented in this FEIS adequately portrays the likely environmental consequences of the proposed action and reasonable alternatives. Volume 2 of the FEIS discusses public participation, and agency consultation and coordination in greater detail.

Based on the range of environmental issues identified by the public during scoping and the agencies' analysis, the agencies identified six significant environmental issues to drive the development of alternatives and evaluation of impacts—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quantity and quality of water resources and effects on aquatic life.

Various alternatives were considered during the scoping process. Alternatives other than the no action alternative and Noranda's proposal were then developed in response to environmental issues to determine whether there was opportunity to minimize the potential adverse effects through modification of planned operations or relocation of any or all of the proposed project facilities. Nine alternatives evaluated in detail in the EIS are—

- Alternative 1–Noranda's mine and transmission line proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3A–full lining of the impoundment and mechanical treatment of all excess water;
- Alternative 3B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Alternative 3C–alternative water management/land application treatment of all excess water.
- Alternative 4–Modified Miller Creek alternative transmission line routing;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action.

Several categories of alternatives were evaluated by Noranda and the agencies, but dismissed from detailed analysis in the FEIS. These alternatives were either technically or economically infeasible, resulted in greater environmental effects, were beyond the ability of the agencies to implement, or offered no advantages to alternatives considered in

detail. The range of alternatives considered include—

- tailings impoundment siting;
- tailings disposal techniques;
- tailings embankment construction methods;
- siting of other mine facilities;
- water treatment methods;
- power supply sources and transmission line routings;
- transmission line construction methods; and
- joint venture mineral development.

ALTERNATIVES DISCUSSED IN THE EIS

Development of the Montanore Project as proposed (Alternative 1) would require disturbing six areas during construction of project facilities (Figure S-1). The mine, mill and two adits would be in upper Ramsey Creek, about one-half mile from the Cabinet Mountains Wilderness boundary. An additional adit, already partially constructed from private land along Libby Creek, would be used for ventilation. A tailings impoundment is proposed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two land application disposal areas would be used for disposal of excess water. Noranda would upgrade the Bear Creek Road (USFS Rd. 278) and two other KNF roads. A transmission line to supply electrical power would be constructed from a newly constructed substation near Sedlak Park to the Ramsey Creek plant site.

The mining project would be developed over a 2- to 3-year period with a peak construction and operations employment of 530 persons. The mine would operate for about 16 years with an operations workforce of 450 persons. Noranda's proposed construction, operations and reclamation plans are described in detail in the Final EIS.

Alternative 2 consists of modifications to Noranda's mine proposal. Modifications proposed by the agencies to Noranda's mine proposal include mitigating measures designed to reduce or eliminate adverse environmental impacts and increase the amount of operational and post-operational monitoring. Alternative 3 consists of Noranda's mine proposal with modifications (as presented in Alternative 2) and with modified water management/treatment. Three water management/treatment options which would result in less change in water quality are described in Alternative 3.

Alternative 4 is Noranda's transmission line proposal with modifications in line location and construction methods. As with Alternative 2, the modifications proposed would reduce or eliminate adverse environmental impacts. Alternative 5 would realign the transmission line route from the upper Miller Creek drainage to the mouth of Ramsey Creek. Alternative 6 would realign the transmission line route from the Fisher River to the mouth of Ramsey Creek. Both alternatives include construction and operation of the transmission line using Noranda's proposed methods, except the modifications described in Alternative 4 would be incorporated. Alternative 7 is the "no action" alternative; Noranda would not develop the Montanore Project.

THE AFFECTED ENVIRONMENT

The proposed project area comprises a 3,424-acre mine permit area and a transmission line corridor. About 1,272 acres are proposed for surface disturbance in the project area. The project area is situated in the Kootenai National Forest, 18 miles south of Libby in northwestern Montana. Elevation of the project area ranges from 2,600 feet along U.S. 2 to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is largely influenced by elevation and topography. Two tributaries of the Kootenai River, Libby Creek and the Fisher River, provide surface water drainage.

Public lands are managed by the KNF under the multiple use policies of the KNF Forest Plan. Small areas of private land occur in the project area.

Timber harvesting, recreation, and wildlife habitat are the predominant land uses. The affected environment is described in detail in the Final EIS.

CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES

Table S-1 provides a side-by-side comparison of the effects of the three mine alternatives and the no action alternative; Table S-2 compares the effects of four transmission line alternatives. (Both tables are presented at the back of this summary.) Detailed descriptions of these alternatives are given in Chapter 2, and a detailed discussion of their impacts is in Chapter 4.

As proposed, the Montanore Project would result in significant impacts in three areas—surface water quality, wildlife habitat, and general forest recreational activity. Some changes also would occur in the socioeconomic environment of Lincoln County and Libby, and in wilderness attributes in the Cabinet Mountains Wilderness. These changes are described in the following sections.

Changes in Water Quality & Effects on Aquatic Life

Water quality. Alternatives 1, 2 and 3 would result in a change in existing water quality. All alternatives would require an authorization from the Board of Health and Environmental Sciences to allow a change in nitrate and ammonia concentrations over ambient stream water quality. An authorization to allow a change in other water quality parameters, such as total dissolved solids or metals, also may be required.

Under Alternatives 1 and 2, increases in total dissolved solids, nutrients, and some metals would occur downstream of the project facilities. The agencies' analysis predicts that these increases would exceed surface or ground water quality standards for nutrients and some metals at some locations during the construction period and following mine operations. The agencies' analysis, however, is based on certain assumptions that may not reflect actual conditions and that cannot be known completely in advance. The agencies used assumptions that are reasonable, conservative, and protective of water quality. Several factors would affect surface water quality after Noranda's discharges. These include actual concentrations of ammonia, nitrates, and metals in both discharge waters and ambient streams, the influence of plant uptake and soil conditions on resulting ground water quality, and the exact locations where surface water quality would be affected. These factors lead to uncertainty over actual project effects; the uncertainty associated with the agencies' analysis is discussed in detail in Chapter 4 of the FEIS. Consequently, surface or ground water quality standards may not be exceeded during the project.

Under Alternative 2, Noranda would change the impoundment design with the objective of reducing the amount of tailings seepage entering ground water. The agencies have described one possible system, gravel drains, estimated to cost about $1.5 million. The system would reduce tailings pond seepage into ground water beneath the impoundment and provide a better opportunity to manage tailings water before entering ground water.

Three water management/treatment options (A, B, and C) have been described under Alternative 3. Under Option A, Noranda would place a synthetic liner beneath the impoundment and treat all excess water. Treated water would be either discharged to a land application disposal area, or discharged directly to area streams, depending on treated water quality. A discharge permit would be required if treated water is discharged directly to surface water. All tailings water probably would be used in the mill. Three "mechanical" water treatment systems—evaporator, reverse osmosis, and ion exchange—have been described and analyzed. Based on lining the impoundment and treating all excess water before, during and after operations with an ion exchange system, conceptual capital and operating costs would be about $27.5 million.

The evaporator system would be the most effective of the three systems considered in Alternative 3. Metals concentrations and nitrate concentrations would be reduced by 99 percent using an evaporator. Reverse osmosis would have similar removal efficiencies for metals, nitrates, and ammonia. Ammonia removal efficiencies in all three treatment systems, and removal efficiencies in general for the ion exchange demineralization system would depend upon specific operating conditions and influent water quality.

Mechanical treatment and subsequent land application treatment would meet applicable water quality standards for most parameters except for certain metals with concentrations which are below detection limits. It is unknown whether these systems would achieve water quality standards for metals that have water quality standards below detection limits. Water quality standards also would be met using these systems for metals with water quality standards above detection limits.

Alternative 3B would require Noranda to treat all excess water having elevated nitrate and ammonia concentrations with a mechanical system prior to discharge. Conceptual capital and operating costs for an ion exchange system would be about $7 million. Under this option, the impoundment would not be lined. Noranda would change the impoundment design with the objective of reducing the amount of tailings seepage entering ground water. Water quality standards are projected to be met for most constituents; the uncertainty associated with certain metals also would be present under Option B.

Before implementing Alternatives 3A or 3B, Noranda would complete additional water quality analyses and prepare final system design for submittal to and approval by the agencies. Additional testing may be required to determine whether concentrations of parameters other than nitrates and ammonia would exceed ambient concentrations.

Noranda would construct additional land application disposal areas in the Little Cherry Creek area under Alternative 3C. Water would be stored during the non-growing season and discharged to land application disposal areas during the growing season only. Capital and operating costs for this option have not been estimated.

Nitrate and ammonia concentrations would be reduced substantially in comparison to year-round discharge to land application (Alternatives 1 and 2). Using the agencies' assumptions and a high range of nitrate and ammonia concentrations, total inorganic nitrogen is projected to exceed 1 mg/L in Year 3 of construction. Projected concentrations are below 1 mg/L using a low range of nitrate and ammonia concentrations. Effects on water quality in Little Cherry Creek are uncertain. The uncertainty associated with certain metals also would be present as discussed under Option A.

Under Alternative 3C, the Board of Health and Environmental Sciences would have to approve Noranda's petition as revised in the supplemental petition information (Noranda Minerals Corp., 1992a). The DHES will recommend to the Board that maximum concentrations of total inorganic nitrogen (nitrates, nitrites, and ammonia) in surface waters be limited to 1 mg/L.

Noranda would conduct additional analysis of adit and mine waters to determine the average nitrate and ammonia concentrations in these waters beginning with Year 1 of construction (discharge would be lowest in Year 1). Additional ground water monitoring also would be instituted in the land application disposal areas to evaluate the effectiveness of land application treatment. Based on this monitoring (described in Appendix B of the FEIS), the agencies would evaluate the likelihood that surface or ground water standards would be exceeded in subsequent years with increased discharged volumes (Years 2 and 3 of construction). If monitoring indicates that ground or surface water standards are or would be exceeded, Noranda would

be required to modify its operating plan. Mechanical treatment using one of the three systems described under Alternative 3A could be required. Other less costly, but equally effective, modifications may be available.

The transmission line alternatives would have little effect on surface water resources. Alternative 7, No Action, would result in no effects on surface water quality. Discharges from the Libby Creek adit, which is permitted by the DSL under a separate action, would continue until closure. Adit closure would be in accordance with the existing permit.

Wetlands. Under Alternatives 1, 2, and 3, the Little Cherry Creek tailings impoundment would fill about 14 acres of wetlands and 5.8 acres of waters of the U.S. It is unknown if Noranda's proposed pressure relief/seepage collection system would affect wetlands downstream of the tailings impoundment. Widening the existing Bear Creek access road would unavoidably fill and cause the direct loss of approximately 0.4 acre of herbaceous/shrub wetlands and less than 0.1 acre of waters of the U.S. Temporary indirect impacts to wetlands and waters of the U.S. would occur during construction due to increased sediment contributions to wetlands and waters of the U.S. Proposed best management practices would reduce sediment contributions to wetlands and waters of the U.S. No other mine facilities would affect wetlands or waters of the U.S.

Noranda has a proposed mitigation plan to create and expand wetlands. Suitable sites exist on- and off-site to develop new wetlands or to expand existing wetlands. Noranda's proposed wetlands monitoring plan would evaluate the success of the mitigation plan. Under Alternatives 2 and 3, the monitoring plan would be continued for a longer period. Intensive monitoring would be conducted every year as proposed by Noranda through Year 5. Less intensive monitoring would be conducted every two years thereafter through the end of production.

Also under Alternatives 2 and 3, additional wetlands would be replaced to mitigate for the uncertainty associated with parts of Noranda's proposal. Noranda also would implement additional fisheries mitigation to mitigate effects to Little Cherry Creek. Additional monitoring of wetlands downstream of the impoundment also would be conducted. No wetlands would be affected by Alternatives 4, 5, and 7. Alternative 6 would affect less than one acre of wetlands.

Fish and other aquatic life. Project area streams are typically low in bedload fine sediment. This is partly the result of high stream flows. The proposed project would result in slight increases in sediment loads and turbidity downstream of the proposed project. Under all action alternatives, impacts to fish and other aquatic life from increased sedimentation would be insignificant—to some extent, a limited increase in sediment to the streambed might actually benefit aquatic life at some locations.

The proposed diversion of Little Cherry Creek and placement of the tailings pond in Little Cherry Creek is estimated to cause a loss of 330 "cuttbow" trout. In addition, the project may affect other populations and habitat of these species due to the release of small gravels or fine sediments from the project area, if such releases are excessive beyond those typically occurring when best management practices to control sediments are implemented adequately.

Alternatives 1 and 2 would result in increased concentrations of minerals and nutrients, which would increase the productivity of many aquatic populations. Nutrients are projected to exceed aquatic life standards based on certain assumptions in the agencies' analysis. Increased algal growth could affect aquatic life adversely, particularly during periods of low flow. Not much is known about the effects of slightly increased metals concentrations on organisms inhabiting very soft waters, such as in the Libby Creek drainage. Baseline metals concentrations indicate some potential risk to aquatic populations, but the extent of risk is not known. Noranda's proposed discharge would increase metals concentrations in Libby and Ramsey creeks.

Under Alternatives 3A and 3B, some or all excess water would be treated with a mechanical system, reducing nutrient and metals concentrations in receiving streams. Secondary treatment would reduce nitrogen concentration at or below which may produce undesirable conditions for aquatic life. Noranda would implement an expanded monitoring program under Alternatives 2 and 3 to evaluate impacts to fish and other aquatic life. Using a high range of nitrate and ammonia concentrations in the analysis, projected concentrations of nitrogen under Alternative 3C during Year 3 would exceed those which may result in growth of undesirable aquatic life. Noranda would conduct additional monitoring and change its operating plans, if necessary, to ensure protection of fish and other aquatic life.

Changes in transmission line construction methods in Alternatives 4, 5, and 6 would slightly reduce the amount of sediment reaching the Fisher River and Ramsey Creek compared to Alternative 1. Existing conditions would be maintained with Alternative 7.

Monitoring. Under Alternative 1, Noranda would implement a water quality monitoring program designed to evaluate the effects of the Montanore Project on surface water quality. The monitoring program is also designed to develop information on water management, particularly on the quantity and quality of tailings impoundment seepage and mine and adit water. Noranda would revise the proposed water management plan in response to the monitoring information.

As part of Alternatives 2 and 3, the agencies have expanded the monitoring program in response to uncertainty perceived in Noranda's proposal. In addition to measures proposed by Noranda, the agencies would require Noranda to analyze excess water for additional metals which may have an environmental effect, and expand the aquatics monitoring to include toxicity testing of tailings, mine and adit waters, metals testing of fish, and evaluating fish populations. A more detailed water quality monitoring plan would be instituted under Alternative 3C.

Changes in Wildlife Habitat

The Cabinet Mountains provide habitat for a small population of grizzly bears, a threatened species. The project area also provides habitat for a variety of other big game wildlife, such as elk, moose, black bear and mountain goat. Project activities would displace these species from some habitat presently used in the area. An increased mortality risk to grizzly bears would result from direct and indirect effects of the project. Moose winter range would be affected in the proposed impoundment area. Effects from the mine, tailings impoundment, and related facilities would extend over the life of the project. Effects on wildlife from the transmission line would be confined mostly to the construction period. Alternative 6 would affect comparably less grizzly bear habitat than Alternatives 1, 4 or 5. New access roads for the transmission line would be closed following construction, and little activity would occur along the line during the operating phase. Elk security areas and big game winter range would be crossed by the transmission line route.

All action alternatives would require mitigation and compensation for effects on grizzly bears. These effects include loss of habitat and increased mortality risk. Two alternative grizzly bear mitigation plans are presented—one developed by Noranda and one by the agencies. Both plans would require Noranda to acquire habitat and to fund wildlife law enforcement and information positions, and the KNF to close roads. Both plans propose that a management committee be established to direct the mitigation program. This committee would consist of members from the U.S. Fish and Wildlife Service, the Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, and Noranda.

In Noranda's proposed grizzly bear mitigation plan, seasonal and year-round road closures would account for about 50 percent of needed habitat

replacement. The other 50 percent would consist of private land acquisitions or conservation easements to be completed within six years of construction startup. Noranda would hold title to these lands or easements. Mortality risk would be reduced through the law enforcement and information positions, and through road closures.

The agencies' grizzly bear mitigation plan would apply to all action alternatives other than Alternative 1. Approximately 35 percent of lost habitat would be mitigated through road closures. The remaining 65 percent would be replaced by Noranda through purchase of private lands or conservation easements. Acquisitions would be completed within six years of construction startup, with 50 percent completed within the first three years. Mortality risk would be reduced through law enforcement and information positions, road closures, and through additional measures to minimize the potential for human-bear interaction. The KNF is in formal consultation with the U.S. Fish and Wildlife Service regarding the proposed grizzly bear mitigation plan. The proposed mitigation plan and its effects could change based on the Fish and Wildlife Service's Biological Opinion.

Effects on wildlife resulting from the project would not occur under Alternative 7.

Changes in General Forest Recreational Activity

During the project construction phase, a significant increase in traffic would occur on the Libby Creek and Bear Creek roads under Alternative 1. The Bear Creek Road would be widened to accommodate the increased traffic. The increased traffic would likely affect recreational users who use the forest for travel and viewing pleasure, the primary recreational use in the project area. Road closures, both those proposed by Noranda and the agencies for grizzly bear mitigation, would reduce motorized recreational opportunity. These closures are in addition to the KNF road closures discussed in Chapter 2 to meet Forest Plan standards. Some of the roads proposed for closure are in areas managed for non-motorized recreation. Closure would increase semi-primitive, non-motorized recreational opportunity in these areas.

The tailings disposal facility (impoundment and dam) would be permanent and would affect the views of the Cabinet Mountains from several locations along Libby Creek Road. Although Noranda's proposed reclamation plan would likely result in reforestation of the impoundment area, the landform created by the facility would remain visually and topographically incongruent with the surrounding landscape.

Other project facilities, such as the plant site and transmission line, also would be visible from locations within the Cabinet Mountains Wilderness. The transmission line would be visible from the Libby Creek Recreation Gold Panning Area and the Howard Lake Campground.

Alternatives developed by the agencies are intended to reduce or avoid these potential impacts. Under Alternatives 2 and 3, Noranda would develop an agency-approved traffic management plan designed to minimize traffic on the access roads during all phases of the project. This mitigation would significantly reduce traffic levels on the Bear Creek Road.

Noranda would implement several modifications to address potential visual effects as part of Alternatives 2 and 3. The two primary modifications are developing three additional viewpoints along the Bear Creek and Libby Creek roads with views focusing on the Cabinet Mountains and developing a roadside tree management program with the goal of obscuring any project facilities along primary travel routes.

Under Alternatives 2 and 3, Noranda would fund improvements at the Libby Creek Recreation Gold Panning Area if warranted by increased use.

Location and Stability of Tailings Impoundment

Tailings would be disposed in an impoundment spanning Little Cherry Creek, requiring a permanent

diversion of the creek around the impoundment. A large population of northern beechfern, a USFS-designated sensitive plant species, would be lost. Noranda's proposed mitigation under Alternative 1 includes transplanting the plants in the impoundment area to undisturbed areas. The success of the proposed transplantation is uncertain. Under Alternatives 2 and 3, Noranda would continue to fund broad-scale inventories for northern beechfern on the KNF, to assess its status more accurately. The inventories would continue until the KNF deems the inventories sufficient. The KNF would develop a conservation strategy based on the accumulated field survey information. As part of this conservation strategy, the KNF would provide permanent protection for other known beechfern populations on the Forest. The number of populations protected would be determined in the conservation stategy. Although some transplanting could be conducted as part of an experimental program, transplanting would not be included as mitigation or compensation for the project. The effects of Alternatives 2 and 3 on the northern beechfern population in Little Cherry Creek would be the same as Alternative 1.

Artesian ground water conditions occur in the impoundment area. Noranda proposes to relieve upward pressure through a pressure relief/seepage interception system. The agencies conclude that a pressure relief system would ensure long-term impoundment stability. Under Alternatives 2 and 3, the agencies would require Noranda to collect additional information prior to final design of the pressure relief well system. Before final design, Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a redundant ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigations would provide more detailed information on artesian pressures within the embankment area.

Changes in the Socioeconomic Environment

Operation of the Montanore Project would create 450 new jobs, and increased business activity in Lincoln County would create another 200 jobs. Employment during the three-year construction phase would be slightly higher. About $13.8 million in annual personal income would result from project operations. A long-term population increase estimated to be 319 people would be less than two percent of the present population in Lincoln County. A peak population increase of 411 people would occur during the construction phase. Increased housing and community services would be necessary to accommodate increased growth. An estimated 90 housing units would be needed by project workers and their families during the operations period; 105 housing units would be needed during the construction phase. No work camps would be developed. Under the Hard Rock Mining Impact Plan, Noranda would pay for all increased costs to local government units resulting from the project.

Under Alternative 7, these socioeconomic changes would not occur. Existing high unemployment levels would likely remain.

Changes in Cabinet Mountains Wilderness

The proposed project would be near the Cabinet Mountains Wilderness, with the proposed plant site and adits adjacent to the wilderness boundary in Ramsey Creek, and the mine extending underneath the Cabinet Mountains Wilderness. Current recreational users of the Ramsey Creek drainage seeking the opportunity for solitude and primitive recreation would likely be displaced. Access to upper Ramsey Creek above the plant site would be restricted. During operations, project facilities would affect the views of climbers of some wilderness peaks (~150 people per year).

Increased noise levels, particularly during construction, and increased concentrations of airborne pollutants would occur in upper Ramsey

Creek. Levels of air-borne pollutants are expected to be well below applicable standards. No surface subsidence and no effects to surface water resources are expected in the wilderness.

Under Alternatives 2 and 3, some noise reduction would occur through mitigation. Increased monitoring would occur for surface and ground water resources, and for air quality around the proposed plant site. The transmission line alternatives would not affect wilderness characteristics.

Under Alternative 7, the current characteristics of the Cabinet Mountains Wilderness would remain. Areas around the proposed plant site would not be affected.

THE AGENCIES' PREFERRED ALTERNATIVES

Mine Alternative

The agencies' preferred alternatives are Alternatives 3C and 5. Alternative 3C would result in construction of the mine, mill, tailings pond, land application disposal areas and access roads. Excess water would be stored and discharged seasonally to land application disposal areas along Ramsey or Little Cherry creeks. Environmental requirements in addition to those proposed by Noranda would be incorporated to minimize or eliminate environmental impacts. Additional monitoring would help detect unacceptable impacts, should they occur. Measures would be developed to respond to and control these impacts.

Recommended Transmission Line Route and Centerline

In evaluating the alternatives, the DNRC and the KNF considered the analysis documented in this FEIS. Based on a weighing and balancing of the information contained in the FEIS, the DNRC and the KNF recommend Alternative 5 as providing the best balance for a route and centerline. Alternative 5 would result in construction of the North Miller route transmission line, and associated facilities, to provide power for the mine and mill.

Table S-1. Comparison of mine alternatives by significant environmental issue.

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Water Resources						
Surface water quality	Slight increases in most metals and total dissolved solids concentrations in project area streams from seepage and discharges during operations. Surface water quality standards for nitrates, ammonia, and manganese projected to be exceeded. Ability to meet surface water quality standards for certain metals uncertain. Noranda would construct a tailings seepage interception system consisting of a series of wells downstream of the impoundment, reducing the amount of seepage reaching surface water. Acid drainage uncertain, but not expected. Comprehensive monitoring plan implemented.	Impacts similar to Alternative 1; slight reduction in potential sediment production with modifications of diversion channel. Increased monitoring of aquatic life, surface and ground water resources during operations. Additional testing required for assessing acid generating potential.	Tailings impoundment fully lined and collected tailings water used in mill during operations. All excess mine and adit water mechanically treated; treated water applied to a land application disposal area. Nitrate, ammonia and metals concentrations at or near ambient concentrations.	Tailings impoundment unlined; gravel drains or similar system installed. Tailings seepage would affect Libby Creek. Excess water with elevated nitrate concentrations mechanically treated; treated water and other excess water applied to a land application disposal area. Projected total nitrogen concentration less than 1 mg/L in all streams.	Tailings impoundment unlined; gravel drains or similar system installed. Storage of excess water and seasonal discharge to land application disposal areas along Ramsey Creek and Little Cherry Creek. Maximum projected total nitrogen concentration in Libby Creek is 1.7 mg/L. Additional monitoring implemented. Some soil uptake (attenuation) of metals would occur.	Existing surface water quality maintained. No increase in sediments. Libby Creek adit site reclaimed in accordance with DSL permit.
Ground water quality	Ground water quality standards for nitrates may be exceeded during construction phase and following operations. Tailings seepage would affect water quality during and following operations. Efficacy of Noranda's seepage interception system uncertain.	Ground water quality standards for nitrates may be exceeded during construction phase and following operations. Tailings seepage would affect water quality during and following operations. Gravel drains or similar system installed. Uncertainty associated with effects on ground and surface water quality reduced.	Impoundment lined; minimal effects on ground water from application of treated water to land application disposal areas.	Gravel drains or similar system installed; ground water effects in tailings impoundment area same as Alternative 2; minimal effects on ground water in land application disposal areas.	Gravel drains or similar system installed; ground water effects in tailings impoundment area same as Alternative 2. Nitrate concentrations reduced substantially by plant uptake.	Existing ground water quality maintained.
Surface water quantity	Slight increase of flow in Libby Creek during low flows; direct surface water withdrawals not anticipated. No subsidence or effects to surface water resources in Cabinet Mountains Wilderness expected.	Mine impacts same as Alternative 1. Surface water withdrawals, if needed, would not occur during average annual low flows.				No change in streamflows. No potential effects on Wilderness Lakes.

Table S-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Wildlife						
Wildlife population and habitat	Physical disturbance of about 1,270 acres; displacement of big game and other wildlife species. Minor disturbance to land application disposal areas.	Winter closure of Big Hoodoo Mtn. Road for moose. Other mitigation would reduce indirect impacts, such as mortality. Other impacts the same as Alternative 1.	Same as Alternative 2 unless land application of treated water not required. Less displacement if land application not required.	Impacts the same as Alternative 2.	Increased land application of excess water in tailings impoundment area. Minor increased disruption of wildlife habitat.	No wildlife habitat affected.
Threatened or endangered species Impacts	Loss of 785 habitat units during mine operations, temporary effect to 562 habitat units during mine construction and 177 habitat units during transmission line construction. Temporary displacement of grizzly bears and increased mortality risk.	Impacts the same as Alternative 1 for mine alternatives. Difference in amounts of affected habitat during construction, depending on transmission line alternatives (see Table S-2).				No changes in wildlife.
Proposed mitigation	Noranda would provide a letter of credit, trust fund, bond or similar financial instrument to ensure plan implementation. Replacement of habitat loss: 50% through KNF road closures; other 50% by acquiring land or conservation easements on suitable private land over a 6-year period. Salaries of two wildlife professionals funded for increased law enforcement and information and education (I&E) to reduce mortality rate.	Mitigation funded through bond. Noranda would provide yearly payments for new positions. Other mitigation measures, such as bear-proof garbage containers and removal of road kills, would reduce human/grizzly bear contact. Replacement of habitat loss: 35% through KNF road closures; 65% by Noranda's acquiring land or conservation easement at management committee direction over a 6-year period. Salaries of two wildlife professionals funded for life of project for increased law enforcement and I&E.				No mitigation necessary.

Table S-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
General Forest Activities						
Recreational opportunity and use	Displacement of recreational users from Libby, Ramsey and Poorman drainages. Increased use at Howard Lake Campground and Libby Creek Recreation Gold Panning Area. Road closures would modify motorized recreational opportunity to semi-primitive, non-motorized recreational opportunity.	Impacts similar to Alternative 1. Fewer road closures in agencies' grizzly bear mitigation plan. Noranda would accomplish or fund the following mitigation— Improvements made at the Libby Creek Recreation Gold Panning Area if use warrants; and Roadside tree management program developed to obscure views of tailings impoundment and increase views of Cabinet Mountains.				No displacement of users. Developed recreational area use remains at current levels. Bear Creek Road not widened.
Other forest uses (also see Wildlife)	Temporary disturbance of about 1,270 acres; Tailings impoundment and widened Bear Creek Road right-of-way unsuitable for timber harvesting following operations. Increased traffic on Bear Creek Road (500%); road widened to accommodate increased traffic, increasing access. Moderate or high visual impact from project facilities to key viewpoints within forest.	Traffic reduced by car-pooling or busing. New management area developed for tailings impoundment, plant site, and transmission line corridor. Other impacts same as Alternative 1.				Existing multiple uses in project area remain.

Table S-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Cabinet Mountains Wilderness						
Opportunity for solitude and primitive recreation	Recreational users of upper Ramsey Creek (~75 summer users) displaced. Project facilities would affect views of wilderness peaks climbers (~150 people).	Impacts same as Alternative 1.				Current wilderness experience remains unaffected.
Natural integrity and apparent naturalness	Increased concentrations of air-borne pollutants in upper Ramsey Creek. Expected levels well below applicable standards. Increased noise levels, particularly during construction, in upper Ramsey Creek. No visibility impacts. No subsidence or effects on surface water resources in Cabinet Mountains Wilderness expected.	Some noise reduction in wilderness through mitigation measures, such as modification of backup beepers on equipment. Increased monitoring of ground water resources and air quality during operations. Other impacts the same as Alternative 1.				Natural integrity and apparent naturalness maintained. Water resources in wilderness not at risk.
Tailings impoundment						
Stability	Tailings embankment would remain stable even in the event of a maximum credible earthquake. Artesian conditions would be controlled using a passive system of pressure relief wells (~110 by Year 16). Little Cherry Creek diverted around tailings impoundment facility.	Noranda would institute the tailings dam and impoundment monitoring program described in Appendix B. Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigation would provide more detailed information on artesian pressures within the embankment area.				No project facilities constructed.
Location	Would eliminate large population of northern beechfern (USFS-designated sensitive species). Would reroute Little Cherry Creek and eliminate 3 percent of available miles of habitat of Interior redband trout.	KNF would develop conservation plan for remaining northern beechfern on Forest. Noranda would fund habitat improvement and restoration work for Interior redband trout.				Habitat for northern beechfern and Interior redband unaffected. Continued hybridization of Interior redband.

Table S-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Socioeconomics						
Employment	450 new jobs created directly by project and 200 indirect jobs during operation. Construction phase employment slightly higher.	Impacts same as Alternative 1. Noranda would develop written policies concerning local hiring and develop a worker training program.				No new jobs created. Existing high unemployment levels remain.
Population	Increase of 319 people for project life, less than 2 percent increase in Lincoln County. Peak increase of 411 people during construction phase.	Impacts same as Alternative 1.				No project-related population increase.
Income	$13.8 million in annual personal income during operation.	Impacts same as Alternative 1.				No increase in personal income from project.
Housing	A maximum of 153 housing units needed during construction; 110 housing units needed throughout project. Existing housing supply limited and some new housing development expected.	Impacts same as Alternative 1.				No new housing development. Existing housing adequate for current growth.
Community services	Increased need for law enforcement personnel and teachers.	Impacts same as Alternative 1.				No increased demand for community services.
Fiscal	Revenues allocated to local government units by Noranda would pay for increased costs through Impact Plan process.	Impacts same as Alternative 1.				Increased revenues and costs to governmental units would not occur.

Table S-2. Comparison of selected impacts by transmission line alternatives.

FACTOR	ALTERNATIVE 1	4	5	6	COMMENTS
Miles of high and moderate visual effects Miles of low visual effects Miles of very low visual effects Miles of public land crossed Miles of Champion land crossed Miles of other private land crossed	7.0 6.8 2.5 9.3 7.2 0.1	5.0 9.0 2.7 9.4 7.2 0.1	4.8 7.8 3.7 9.1 7.2 ---	5.1 6.2 6.0 11.0 5.6 0.4	Alternatives 4, 5 and 6 would have 0.7 miles of line with high visual effects along U.S. 2. Alternative 1 would have 1.7 miles of high visual impacts due to additional disturbance during line stringing.
Changes required to KNF Plan - total acres for reassignment to transmission line use	369	369	224	254	KNF would adopt new management area (MA 23) covering acres affected along the selected alternative.
Total acres of tree clearing	193	203	183	200	Each route would effect at least one old growth stand less than 50 acres in size. The number of these small stands would increase as follows: Alternative 1 (4); Alternative 4 (3); Alternative 5 (1); and Alternative 6 (2).
Acres of old growth habitat removed	50	61	46	74	
Acres of old growth habitat affected (clearing and fragmentation)	130	202	140	155	
Old growth habitat < 50 acres	6-7	6-7	2-3	3-4	
Miles of road on erodible land types	4.1	1.6	1.4	1.0	DNRC and KNF would approve final design.
Miles of road on other land types	11.0	6.1	5.3	5.0	
Number of perennial streams requiring new crossings	5	1	0	0	All perennial streams could be crossed using existing bridges, except Miller Creek, where the bridge was washed out. Under Alternative 1, 5 streams would be crossed by a crawler tractor used to string the line.
Number of structures on designated floodplains	2-3	2	1	1	Crossings of designated floodplain on Fisher River would require review by the DNRC and Lincoln County Disaster and Emergency Services Coordinator.
Number of intermittent streams crossed by centerline	20	19	16	10	Intermittent streams are shown on 7.5 minute quadrangle USGS maps.
Number of intermittent streams crossed by roads	15-16	5-6	5-6	5	More streams crossed by Alternative 1 due to the use of crawler tractor for line stringing.

Table S-2. Comparison of selected impacts by transmission line alternatives (cont'd).

FACTOR	ALTERNATIVE 1	4	5	6	COMMENTS
Jurisdictional wetlands affected (acres)	0	0	0	<1	The Swamp Creek alternative would affect less than 1 acre wetland. Other wetlands would be avoided.
Effects on grizzly bear					
habitat units temporarily affected during construction	177	177	463	198	Mainly short-term impacts during construction; proposed mitigation includes timing restriction on line construction during spring.
miles of transmission line in grizzly bear habitat	8.9	8.9	6.5	3.6	
miles of new access road in grizzly bear habitat	4.7	4.7	4.1	1.2	All access roads in grizzly bear habitat closed following construction.
Total miles of elk security area crossed by—					All new roads built for transmission line construction would be closed to public travel.
line	1.8	1.6	1.3	0.3	
roads	3.0	1.4	0.8	0.1	
Total miles of big game winter range crossed by—					Construction timing would be used to avoid impacts to animals using winter range.
line	3.8	4.4	3.6	0.4	
roads	2.8	2.6	2.0	0.3	

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THE EIS AND PERMITTING PROCESS FOR THE MONTANORE PROJECT

THIS final Environmental Impact Statement (FEIS) for the Montanore Project documents the analysis of the possible environmental consequences of a proposed action and alternative actions. The proposed action—the construction and operation of the Montanore Project—and six alternatives have been developed and analyzed in this EIS. The purpose and need for the proposed action and the agencies involved with the EIS and permitting process for the Montanore Project are described in the following sections.

PURPOSE AND NEED

The Proposed Action—the Montanore Project

The "Montanore Project" is a proposed underground copper and silver mine in northwestern Montana. The project is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. Noranda would be the operator. The mine would be in Sanders County, and the mill and other facilities would be located in Lincoln County, about 18 miles south of Libby, Montana (Figure 1-1). Noranda currently holds mineral rights within the Cabinet Mountain Wilderness. The purpose of the proposed action is to develop these interests with the Montanore Project. The project would include constructing a mill for ore processing and associated mine waste disposal facilities. The proposed project also would require constructing about 16 miles of high voltage electric transmission line to the project site. Noranda's proposed plan of operation is described in more detail in Chapter 2.

NEPA, MEPA, and MFSA

Procedures governing the EIS analysis process in Montana are defined in administrative rules implementing the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA), and the Montana Major Facility Siting Act (MFSA). These laws require that if any action taken by the State of Montana or the U.S. Forest Service

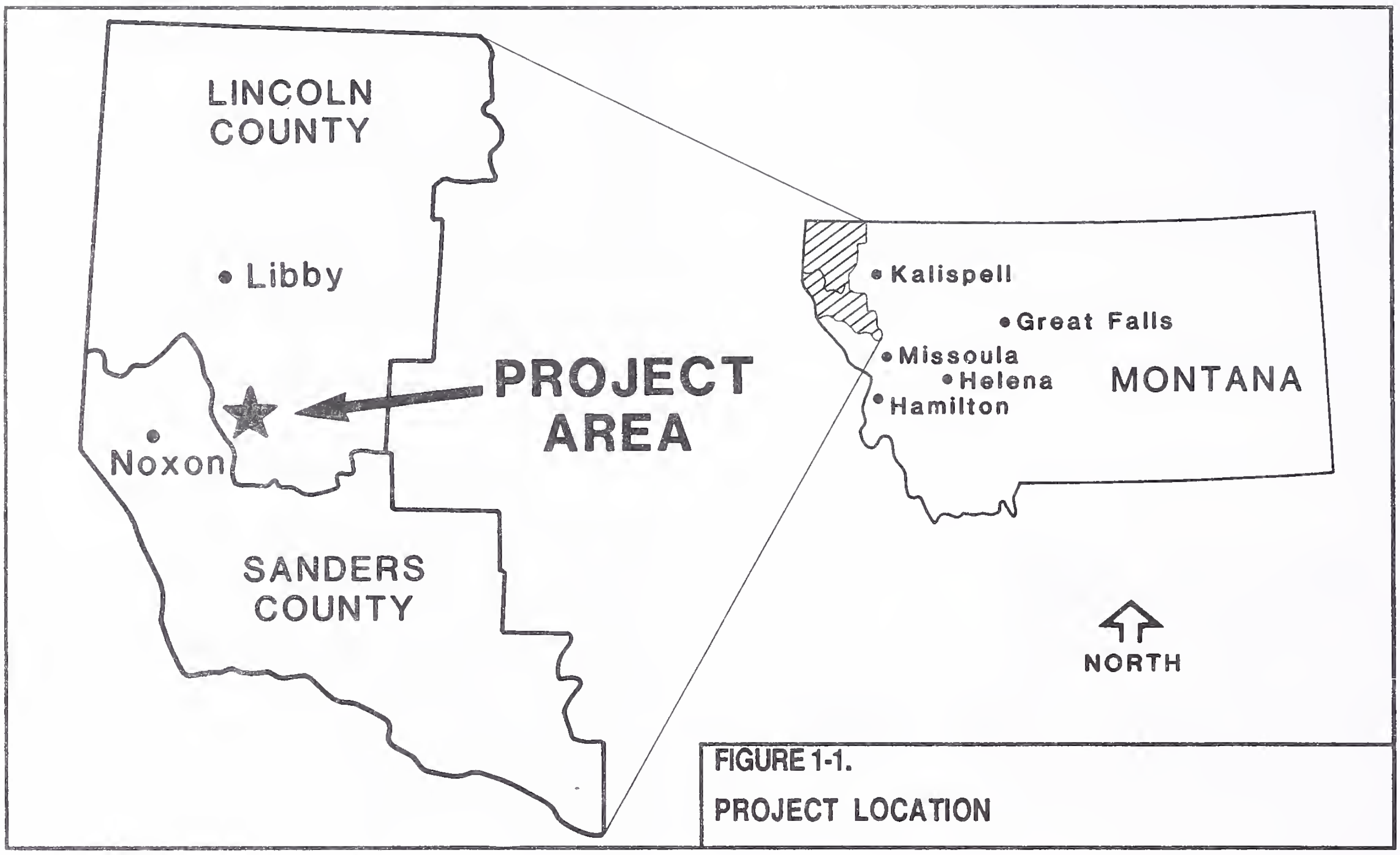


FIGURE 1-1.
PROJECT LOCATION

may "significantly affect the quality of the human environment," an EIS must be prepared. This FEIS was written to meet the requirements of these statutes and the administrative rules and regulations implementing these laws adopted by participating state or federal agencies.

AGENCIES' ROLES AND RESPONSIBILITIES

Four "lead" agencies have been designated for this project. The lead agencies are the Kootenai National Forest (KNF), the Montana Department of State Lands (DSL), the Montana Department of Natural Resources and Conservation (DNRC), and the Montana Department of Health and Environmental Sciences (DHES). Lead agency approvals required for the Montanore Project would be major federal or state actions each requiring an EIS under NEPA, MEPA or MFSA. A single EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. In addition to approvals by the lead agencies required for the Montanore Project, various other permits, licenses or approvals from other agencies also would be necessary (Table 1-1). The roles and responsibilities of the lead agencies and other agencies with permitting and regulatory responsibilities are discussed in the following sections.

Kootenai National Forest

A majority of the proposed Montanore Project facilities and all of the ore deposit are on lands administered by the Kootenai National Forest. The Organic Administration Act authorizes the Secretary of Agriculture to regulate occupancy and use of national forest lands for the protection and management of forest resources. Regulations for mining activities

Table 1-1. Permits, licenses, and approvals required for the Montanore Project.

Permit, License or Approval	Purpose
Forest Service	
Approval of Plan of Operation (36 CFR 228 Subpart A)	To allow Noranda to construct and operate a mine and related facilities on Forest System lands. Approval incorporates management requirements to minimize or eliminate effects on other forest resources. Approval is documented in a Record of Decision.
Special Use Permit(s)	To allow respective utility companies to construct and operate electric transmission/distribution and telephone lines and to allow Noranda to construct and maintain associated facilities such as a weather station or radio tower, outside the designated project area on Forest System lands.
Road Use Permit	To specify operation and maintenance responsibilities on Forest System roads used for commercial hauling of ore concentrate.
Mineral Material Permit	To allow Noranda to take borrow material from Forest System lands outside mining claims or mill sites.
Timber Sale Contract	To allow Noranda to harvest commercial timber from the project area within Forest System lands. Harvesting would be conducted to clear area for project facilities.
Cultural Resource Clearance	To obtain joint approval by the Forest Service and State Historic Preservation Office prior to construction activities.
Final Design Approval of Facilities	To ensure consistency of design of plant/ portal site, conveyor system, waste rock disposal site, access roads, utility corridors, waste water treatment facilities, and tailings disposal impoundment with preliminary plans. Coordinate with DSL and other appropriate agencies.
Monitoring Plans	To assure compliance with state and federal environmental resource standards and criteria. Coordinate with other governmental agencies.
Reclamation Bond	To post a sufficient bond prior to commencing construction. Bond would be coordinated with and held by DSL for the mining operation. The KNF would hold the bond for NFS lands affected by the transmission line.
Department of State Lands	
State Operating Permit (Metal Mine Reclamation Act)	To allow mining development activity.
Reclamation Bond	To post a sufficient bond with the state prior to commencing construction. Coordinate with Forest Service.
Monitoring Plans	To assure compliance with state and federal environmental standards and criteria. Coordinate with other governmental agencies.
Department and Board of Health and Environmental Sciences Air Quality Bureau	
Air Quality Permit (Clean Air Act)	To control particulate emissions of more than 25 tons per year.

Table 1-1. Permits, licenses, and approvals required of the Montanore Project (cont'd).

Permit, License or Approval	Purpose
Department and Board of Health and Environmental Sciences—Water Quality Bureau	
Change in Quality of Ambient Waters (Water Quality Act)	To allow for changes in ground and surface water quality.
Ground water Discharge Permit	A ground water discharge permit from the DHES is not needed [ARM 16.20.1012 (m)]. Draft rules under consideration by the DHES would require a ground water discharge permit from the DHES for discharges to the land application disposal areas.
Storm water Discharge Permit (Water Quality Act)	To allow discharge of storm waters from mine access roads.
Water Quality Waiver of Turbidity	To allow for short-term increases in surface water turbidity during construction.
Department and Board of Natural Resources and Conservation	
Water Rights Permit (Montana Water Use Act)	To allow beneficial use of state waters obtained through any surface water diversion or through ground water withdrawal exceeding 100 gallons per minute.
Certificate of Environmental Compatibility and Public Need (Major Facility Siting Act)	To construct 230-kV electrical transmission line to supply power to the mine.
Department of Fish, Wildlife and Parks	
FG Form 124 (Stream Preservation Act)	To allow construction activities within the mean high water line of a perennial stream or river.
Bonneville Power Administration	
Record of Decision (National Environmental Policy Act)	To construct, operate and maintain substation and to provide service to the mine power supplier.
Army Corps of Engineers	
404 Permit (Clean Water Act)	To control discharge of dredged or fill material into waters of the United States or on wetlands. Review by the EPA and the DHES.
Lincoln Conservation District	
310 Permit (Natural Streambed and Land Preservation Act)	To allow any activity within the mean high water line of a perennial stream. The Montana DFWP provides recommendations and consultation.
Hard Rock Impact Board/"Affected local government units"	
Fiscal Impact Plan (Hard Rock Mining Impact Act)	To mitigate fiscal impacts on local government services.

on national forest lands are contained in 36 Code of Federal Regulations (CFR) Part 228, Subpart A. These regulations require that a proposed plan of operation be submitted for activities that could result in significant disturbance to surface resources. Regulations for special uses on national forest lands are contained in 36 CFR 251. These regulations require that a special use application be filed for uses such as constructing and operating a transmission line. Both sets of regulations require that an applicant describe the proposed operation, environmental protection measures, and reclamation plans.

Noranda has submitted a proposed plan of operation and special use application for the Montanore Project to the KNF (Noranda Minerals Corp., 1989a). The Supervisor of the KNF will issue his decision with respect to Noranda's proposal in a Record of Decision (see *Agency Decisions* in this Chapter). Noranda may appeal the decision pursuant to 36 CFR Part 217 or 251. Other parties wishing to appeal the decision may do so in accordance with appeal procedures provided in 36 CFR Part 217.

The KNF shares responsibility to monitor and inspect the Montanore Project, and has authority to ensure that impacts to surface resources are minimized through modifications to an approved Plan of Operation. The DSL would collect a bond from Noranda to ensure that the lands involved with the mining operation are properly reclaimed. (DSL's bonding is discussed in a subsequent section.) The bond would be held to ensure performance of the state permit and Forest Service plan of operations, as stipulated in a 1989 Memorandum of Understanding between the Forest Service–Northern Region and the DSL. The KNF may require an additional bond if it determines that the bond held by the DSL is not adequate to reclaim National Forest System lands or would be administratively unavailable to meet Forest Service requirements. The KNF would collect a reclamation bond for National Forest System lands affected by the transmission line. The DNRC would collect a reclamation bond for private lands affected by the transmission line.

Biological Assessment. The KNF is required by the Endangered Species Act to ensure that any actions it approves will not jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat. The KNF has prepared a Biological Assessment that evaluates the potential effect on threatened or endangered species that may be present in the area. The evaluation includes any measures the KNF believes are needed to minimize or compensate for effects on the species. The Biological Assessment is presented in Appendix C. It has been submitted to the U.S. Fish and Wildlife Service (USFWS) as part of a formal consultation process.

Mineral rights. The Montanore Project ore body is located within the Cabinet Mountains Wilderness (CMW). The mineral rights were purchased from U.S. Borax and Chemical Corporation (Borax) in 1988 by Noranda and its partner, Montana Reserves. Noranda has claimed this ore under rights granted by the General Mining Law of 1872, as amended, and the Wilderness Act of 1964. The General Mining Law grants citizens the right to prospect for, lay claim to, and develop certain minerals such as copper and silver on public domain lands open to mineral entry.

The CMW was open to mineral entry until January 1, 1984. At that time, it was withdrawn from mineral entry under provisions of the Wilderness Act, subject to valid existing rights. To establish valid existing rights, mining claimants must show that they had made a discovery of a valuable mineral deposit on the claim(s) prior to the withdrawal date, and maintained that discovery to the present. The Forest Service's role is not to adjudicate the mineral rights of claimants, but rather to ensure that valid rights have been established prior to approving an operation in the wilderness. A 1985 Forest Service mineral report and subsequent Regional Forester decision verified that Borax (Noranda's predecessor) had established valid rights to minerals within the CMW. Since that time, the Forest Service has continued to review the status and limits of those mineral rights.

More information on the mining claims and Noranda's mineral rights is presented below.

In 1982 and 1983, Pacific Coast Mines, Inc. (a corporate affiliate of Borax) located 202 individual lode mining claims within the CMW in an area between Rock Lake and Hayes Ridge. These claims are referred to as the HR claim group. Borax found a mineralized outcrop on these claims adjacent to Rock Lake in 1983. This outcrop contained stratabound copper-silver mineralization, extending over a 200-foot vertical thickness. This disseminated mineralization was identical in nature to, but much thicker than, that discovered in the outcrop at ASARCO's Spar Lake (now the Troy Mine) and Rock Creek deposits. The outcrop was sampled in 1983 by Borax, and jointly by the Forest Service and U.S. Bureau of Mines. Borax subsequently requested and was granted approval by the KNF to core drill on this mineralized outcrop. Initial drilling was conducted on the outcrop in 1983. Additional drilling was conducted in 1984. Borax also drilled two core holes in 1983 on the HR claims near the East Fork of the Bull River.

Based on the drilling, surface sampling, geologic mapping and other data, Borax concluded they had discovered the apex of a large, stratabound copper-silver deposit. An apex is the top or highest point along a dipping lode or vein. The company believed that the apex was at the mineralized outcrop adjacent to Rock Lake, and that they had extralateral rights associated with that apex. The General Mining Law entitles a claimant to mineralization extending in a downward course off the sidelines, but within the endlines of the apex claims. This is referred to as extralateral rights.

Borax wanted to continue development drilling on the copper-silver ore body. Before they could conduct this drilling, however, the Forest Service had to verify that Borax had established valid existing rights prior to the wilderness withdrawal. The Forest Service conducted a mining claim validity investigation for that purpose. The investigation included field and map review of claim locations, an examination of the claim and area geology, review and sampling of drill cores and the discovery outcrop, and sampling of other mineral exposures within the claims. These other mineral exposures consisted of pits and workings in and near the St. Paul Pass area. The results and findings of the claim examination were documented in a Forest Service mineral report dated February 27, 1985. This report is available at the KNF. Its purpose was to assess what rights, if any, Borax had established in the wilderness, and to make recommendations on whether they should be allowed to conduct development drilling operations.

The Forest Service mineral report concluded that Borax had discoveries constituting valid existing rights on four of the 202 HR mining claims: Claims 72, 73, 133 and 134. The report stated that inferred reserves extended to the northwest beyond the mineralized outcrop near Rock Lake and that Borax had extralateral rights to develop and mine these reserves because of their discovery of the apex and location of the four lode claims over the apex. The Forest Service mineral report also concluded that none of the remaining 198 claims had exposures of valuable mineral deposits within their boundaries.

Based on the conclusions and recommendations in the mineral report, the Regional Forester issued a decision on February 28, 1985 stating that Borax had established valid existing rights in the Cabinet Mountains Wilderness and directing the KNF to process Borax's proposal to continue development of the claims by further drilling. This was a decision regarding valid existing rights—enabling the Forest Service to process plans of operation for activities within the CMW—as opposed to a decision regarding either issuance of mineral patents or whether to initiate contest proceedings against a mining claimant. The Forest Service does make recommendations to the BLM for mining claims on National Forest System lands, regarding whether the BLM should issue mineral patents or whether the BLM should initiate a contest proceeding to have the

Department of Interior declare a mining claim invalid. However, although the Forest Service has the authority to make valid existing rights determinations prior to processing operating plans in wilderness, only the BLM has the authority to make decisions on issuance of mineral patents and initiation of contest proceedings.

Following the Regional Forester's February 28, 1985 decision, the KNF approved Borax's proposal to drill beyond the sidelines of the valid claims. The purpose of the drilling was to develop the property and delineate the full extent of their extralateral rights. Borax drilled a total of 27 core holes from 8 separate sites within the known deposit area in 1985, 1986, and 1987. Twenty-five of these holes penetrated ore grade mineralization. One drill hole penetrated the Rock Lake Fault without encountering the mineralization. Borax abandoned one hole prior to reaching a mineral intercept. Forest Service personnel carefully monitored these drilling activities to ensure compliance with environmental requirements.

Throughout the three years of drilling, the Forest Service also continued to review whether Borax had valid existing rights. Borax provided all of their drill data to the Forest Service, including drill logs, assay and geochemical values obtained from drill samples, and down-hole survey data. Borax also provided the Forest Service full access to examine and independently sample the drill cores. Through review of both Borax's and their own data, the Forest Service was able to determine—based on the most recent geologic and economic data—that Borax still had valid existing rights for the four HR claims.

Borax sold the HR claim block to Noranda and Montana Reserves in September 1988. Noranda's Montanore Project, the proposed action for this EIS, is a mining proposal to develop lode mining claims HR 133 and 134, including extralateral rights associated with those two claims. Claims HR 133 and 134 are two of the four claims for which the Regional Forester's February 28, 1985 decision determined U.S. Borax had valid existing rights. Figure 1-2 shows Noranda's depiction of the location of claims HR 133 and 134 and the extralateral rights extending from those two claims.

In 1991, Noranda filed an application for patent of the HR 133 and 134 mining claims with the BLM (Noranda Minerals Corp., 1991a). A 1957 agreement between the Forest Service and the BLM provides procedures for handling patent applications for mineral lands within National Forests. That agreement provides that upon receiving an application for patent to mineral lands within a national forest, the BLM manager will forward a copy of the application to the Forest Service. Subsequently, the Forest Service has the responsibility to make any necessary mineral examination and report. The Regional Forester then makes a recommendation to BLM regarding whether to issue patent or to initiate a government contest against the application.

Consistent with this agreement, the BLM has forwarded to the Forest Service a copy of Noranda's patent application for HR 133 and 134. The Forest Service is in the process of evaluating the application. The Forest Service will conduct an investigation and report their conclusions to assist the Regional Forester in his recommendation to BLM. The Forest Service does not anticipate that the Regional Forester will complete his recommendations to BLM by the issuance date of this Final EIS.

If the BLM does issue patent, Noranda would obtain title to the mining claim and any attendant rights, such as the portion of the mineral deposit extending in a downward course beyond the sidelines of the claims (extralateral rights). As mentioned previously, Figure 1-2 depicts only the extralateral rights portion of the mineral deposit, and not the entire ore deposit. The deposit is larger than shown in Figure 1-2, extending further east beyond the limits of Noranda's extralateral rights. Noranda only has the right to mine the extralateral rights portion of the ore body, and not the additional portion of the deposit. The BLM will determine the exact limits of

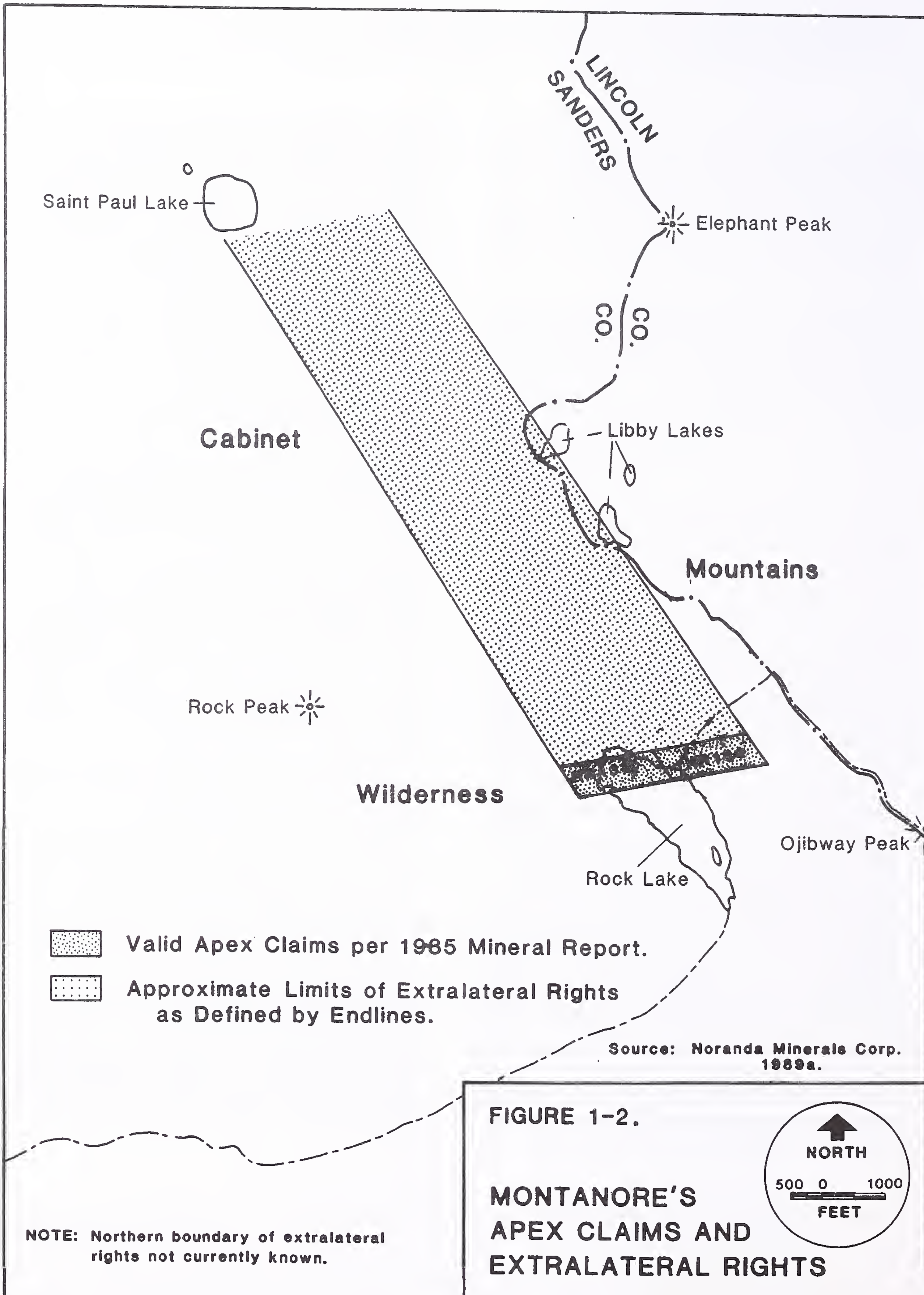


FIGURE 1-2.

MONTANORE'S APEX CLAIMS AND EXTRALATERAL RIGHTS

these rights in part by a detailed survey of the claims, which Noranda has already submitted to the BLM.

Noranda's patent application near Rock Lake encompasses approximately 36.8 acres. The claims straddle the wilderness boundary, with about 22.1 acres inside the Cabinet Mountains Wilderness and the remaining 14.5 acres outside the wilderness. If patented, Noranda would only obtain title to the mineral estate for the portion of the claims within the wilderness. For the portion of the claims outside the wilderness, Noranda would obtain title to both the surface and mineral estate if the claims were patented. Post-operational management of patented lands is discussed under Alternative 2 in Chapter 2.

Montana Department of State Lands

The Montana Department of State Lands administers the Montana Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3, MCA), under which Noranda has applied for a mine operating permit (Noranda Minerals Corp., 1989a). The purpose of this law is to prevent land and surface water degradation by requiring lands disturbed by mining to be stabilized and reclaimed. The Metal Mine Reclamation Act requires an approved operating permit for all mining activities which disturb more than five acres, or mine more than 36,500 tons of ore annually. Noranda's permit application contains environmental baseline information and a plan of operation and reclamation. The application includes descriptions of proposed mining and milling methods, engineering designs, surface facilities, waste disposal practices, erosion and pollution control systems, reclamation methods, and environmental monitoring procedures.

The DSL must decide whether to issue Noranda an operating permit, and if so, under what conditions (see *Agency Decisions* in this chapter). The Montana State Land Commissioner may make a decision to approve Noranda's permit application no sooner than 15 days following publication of the final EIS. Before an operating permit may be issued, a reclamation performance bond must be posted with the DSL. The bond amount must be sufficient for the state to complete reclamation in case of default by the operator.

Major changes in the operating or reclamation plans would require prior approval by the DSL. The DSL would routinely conduct inspections of the Montanore Project to ensure compliance with approved plans. Monitoring data collected by Noranda would be evaluated and, if necessary, compliance monitoring would be performed. Monitoring activities would be coordinated with other state and federal agencies. The DSL can issue notices of violation and levy civil penalties in enforcing its regulations.

The DSL is authorized to bond mining operations under the Metal Mine Reclamation Act. The DSL currently calculates bonds for reclamation which includes returning the site to comparable stability and utility and includes assuring that there are no continuing impacts to the environment. Consequently, neutralization of chemicals or long term water treatment are often a part of the bonding calculations. Bonding for water treatment is usually calculated separately and is based on the volume of water which must be treated, the expected water quality, the treatment method which would probably be used, and the disposal of filtered material.

The amount of bond for reclamation is site specific. Calculations are based on the construction costs of the reclamation. These construction costs include grading roads, parking lots, embankments, diversion channels, ponds, impoundments, and replacing topsoil on all disturbed areas. Costs for reclamation depend on the volume of borrow required to grade, the distance the material must be moved, and volumes of and distances to move topsoil for proper placement. In addition, if any capping materials or other special handling or treatment are required as a part of the reclamation plan, volumes and distances hauled are part of the calculation. Bond calculations also include the costs of revegetation, fertilization, temporary irrigation, demolition of buildings and

other structures, portal plugging, and restriction of access to the site. Bonding includes implementation of monitoring for 5 years after the mine closes and contingency costs for accidents. The calculations also include 15 percent overhead costs. The DSL must have possession of the reclamation bond before issuing a permit.

Montana Department of Natural Resources and Conservation

The Department of Natural Resources and Conservation (DNRC) administers two acts that can apply to mining development in Montana—the Montana Major Facility Siting Act (MFSA) and the Montana Water Use Act. Noranda has submitted an application for approval to construct a 230-kV electrical transmission line pursuant to MFSA requirements (Noranda Minerals Corp., 1989c). Noranda has applied for and will be required to obtain water use permits prior to start of construction.

Montana Major Facility Siting Act. The Montana Major Facility Siting Act requires approval of any electrical transmission line as large as the line proposed by Noranda. Because the purpose of the transmission line is to provide power for operation of the Montanore mine and would be used by Noranda for that purpose, the line qualifies as a non-utility facility under the requirements of Major Facility Siting Act. Section 75-20-301 (4) MCA states- "Considerations of need, public need, or public convenience and necessity in demonstration thereof by the applicant shall apply only to utility facilities." Therefore, the decision by the Board of Natural Resources and Conservation (BNRC) will be limited to those decision factors in the Major Facility Siting Act necessary to determine the siting of the proposed transmission line and to find compliance with the minimum impact standards contained in administrative rules (36-7-3507 and 3508 ARM) adopted by the BNRC. The record for the decision will be developed through the hearing process described in following sections.

For a transmission line as proposed by Noranda, the MFSA requires the BNRC to determine whether a proposed project is designed properly and located to minimize adverse impacts, considering the state of available technology, and the nature and economics of the alternatives. In making its determination, the BNRC will hold a contested case hearing and consider analysis prepared by the DNRC, and any other parties participating in the hearing.

The DNRC prepares recommendations for the BNRC regarding where and how the lines should be constructed, how the line should be operated, and how impacts could be mitigated. These recommendations are included along with DNRC's analyses in the FEIS. The BNRC also will issue a Record of Decision for the transmission line following completion of the hearing process.

The DHES is required to determine whether transmission line construction requires air quality, water quality, or solid waste disposal permits. On July 13, 1990, the DHES determined that the construction, operation, and maintenance of the proposed transmission line along alternative locations under DNRC's consideration would comply with the laws under DHES' jurisdiction if certain conditions were met. The DHES' determination is on file at the agencies' offices.

The Major Facility Siting Act provides for a two-step decision-making process in which the BNRC first considers a route or a general location for a proposed transmission line and then considers more detailed centerline locations (including actual pole and access road right-of-way locations where necessary) within the approved route. Because of the length of the proposed transmission line, the large areas of federal land crossed, and the need for coordinated decision-making, the DNRC and the KNF have jointly conducted an analysis with enough detail to provide concurrent route and centerline recommendations to the BNRC.

The DEIS documents the analysis of a varied width route drawn along a tentative (or reference) centerline

alignment. Further adjustments were made to the alignment following the publication of the DEIS. The route analysis is incorporated by reference into this FEIS. In the Supplemental DEIS, the agencies took the opportunity to present a detailed centerline analysis and to recommend the agencies' preferred route and centerline for the proposed transmission line. Comments on the route analysis in the DEIS and the centerline analysis contained in the Supplement are responded to in this FEIS.

Following publication of the FEIS, the BNRC will conduct a hearing to establish a record for its decision-making. The analysis in the EIS will be a part of the record, as well as other information submitted by persons wishing to provide evidence for the BNRC's consideration on the project.

The BNRC's hearing is a formal legal process open to any person who wishes to participate. The hearing will be conducted by a hearings examiner under provisions of the Montana Major Facility Siting Act and the Montana Administrative Procedure Act. Under Montana law, any affected person who elects not to participate in the hearing before the BNRC waives the right to appeal a decision by the BNRC. Participants are not required to have an attorney, but all persons presenting information to the BNRC will be under oath and subject to cross examination by other parties to the hearing. The DNRC will give notice of the dates for the BNRC proceedings to persons participating in the EIS process. Depending on the issues agreed to by the active participants to the hearing, the Major Facility Siting Act provides mechanisms to expedite the hearing process.

After the formal hearing, a report, prepared by the hearings examiner, will be presented to the BNRC. The BNRC will discuss this report and make its decision at a meeting open to all who wish to attend. In making its findings, the BNRC will consider the analysis and information in the EIS and testimony presented at the contested case hearing.

In selecting a preferred route and final centerline, the BNRC will use preferred route criteria and decision standards established by administrative rules. If the BNRC concurrently approves the route and centerline, it will approve a 500-foot-wide strip. The approved location will provide Noranda with flexibility to adjust the location of its facilities within the strip to accommodate site-specific factors and field conditions, such as wetlands. Following a decision by the BNRC, the KNF will issue a Record of Decision describing its decision on Noranda's project proposal. The KNF may require preparation of a project work plan detailing the final location of poles and access roads across KNF land. The DNRC and the KNF would cooperate to monitor construction of the proposed transmission line consistent with any conditions the BNRC may specify as a condition of its approval. The KNF also may require additional measures to be taken on National Forest System land as part of its decision-making process.

Montana Water Use Act. The Montana Water Use Act established a permit system for the acquisition of a water right. If a developer does not have an existing water right, the law requires a water use permit before water can be put to beneficial use. Noranda's water use during operations would be a beneficial use allowed by law. Since Noranda does not have an existing permanent water right, Noranda would be required to obtain water use permits for ground water or surface waters used in the construction or operation of the mine and mill. Based on the permit application submitted to the DSL, Noranda would be required to obtain permits for the use of ground water for domestic purposes at the mine site, and for mine construction and operation. Ground water would be withdrawn through a well in the project area and from adits in Ramsey Creek or Libby Creek. Noranda has applied for a water use permit for withdrawal of ground water at a rate of 1,200 gallons per minute, not to exceed a total diversion of 2,567.76 acre-feet per year. Noranda will be required to obtain necessary permits before construction begins.

The DNRC is responsible for determining whether water use permits could be issued for ground water withdrawals up to 3,000 acre-feet per year. Noranda would be required to prove by substantial and credible evidence that the following criteria in 85-2-311(1), MCA would be met—

- there are unappropriated waters in the source of supply at the proposed point of diversion at times when water can be put to the proposed use by the applicant; in the amount the applicant seeks to appropriate; and during the period in which the applicant seeks to appropriate, the amount requested is reasonably available;
- the water rights of a prior appropriation will not be adversely affected;
- the proposed means of diversion, construction, and operation of the appropriation works are adequate;
- the proposed use of water is a beneficial use;
- the proposed use will not interfere unreasonably with other planned uses or developments for which a permit has been issued or for which water has been reserved; and
- the applicant has a possessory interest (ownership), or the written consent of the person with the possessory interest, in the property where the water is to be put to beneficial use.

Based on its analysis of the permit application and the above criteria, the DNRC will grant, deny, or condition, in whole or in part, the application for a permit. If objections are filed on Noranda's application, the above determination must be made in a contested case hearing held by the DNRC.

Montana Department of Health and Environmental Sciences

The Montana Department of Health and Environmental Sciences administers the Montana Clean Air Act and the Montana Water Quality Act. The DHES also must concur with the U.S. Army Corps of Engineers' decision regarding Noranda's 404 permit application (see U.S. Army Corps of Engineers discussion).

Air Quality Bureau. The Air Quality Bureau administers the Montana Clean Air Act. Any proposed project having estimated pollutant emissions (without emissions controls) exceeding 25 tons per year must obtain an air quality permit. Noranda has applied to the Air Quality Bureau for an air quality permit for the Montanore Project (TRC Environmental Consultants, Inc., 1989). The permit would specify air emissions limitations and monitoring requirements. Noranda must apply Best Available Control Technology to each emissions source, and must demonstrate that the project would not violate Montana or federal Ambient Air Quality Standards. The Air Quality Bureau would conduct periodic inspections to ensure permit compliance.

Water Quality Bureau. The Water Quality Bureau is responsible for administration of the Montana Water Quality Act. This law provides a framework for the classification of surface and ground water uses. It also establishes water quality standards as well as permit programs to control the discharge of pollutants into state waters.

Mining operations must comply with Montana surface and ground water standards. The tailings impoundment, land application disposal areas, sewage treatment plant and other facilities must be constructed and operated to prevent water discharge, seepage, drainage, infiltration, or flow that may degrade surface or ground waters. Final design plans for the tailings pond, sewage treatment plant, and other facilities proposed by Noranda must be approved by the Water Quality Bureau prior to construction. A short-term exemption from surface water quality standards for turbidity may be required for construction of the transmission line and access roads at stream crossings, and for the construction of the substation near Sedlak Creek.

Noranda has petitioned the Board of Health and Environmental Sciences (BHES) through the Water Quality Bureau for a change in quality of ambient waters (Noranda Minerals Corporation, 1989h). This petition has been modified to reflect Noranda's

current proposed discharges and requested change in water quality limits (Noranda Minerals Corp., 1992a). The petition describes the proposed change in water quality and considers various water disposal alternatives.

This EIS documents the agencies' analysis on the effects of Noranda's discharges on water quality. The agencies recommend a preferred alternative (see Chapter 5) and will submit the FEIS to the BHES. Following a review of the EIS and a public hearing, the BHES will make its decision. To approve a change in water quality, the BHES must find that the proposed change would not preclude present or anticipated use of surface or ground water, and that there is an economic and social need for the project. The hearing procedures the BHES will use are based on those described in the nondegradation section of water quality rules (Administrative Rules of Montana §16.20.705 [5]). The Water Quality Bureau will send hearing notices to all persons who have participated in the EIS process. The final BHES action will be documented in a Record of Decision.

Solid and Hazardous Waste Bureau. The Solid and Hazardous Waste Bureau is responsible for reviewing the mine and transmission line construction and operation procedures to ensure implementation of construction and operational plans comply with solid and hazardous waste laws and regulations.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) has responsibilities under the Endangered Species Act and the Bald Eagle Protection Act. The KNF has submitted a Biological Assessment to the USFWS as part of the formal consultation process required by the Endangered Species Act. The Biological Assessment evaluates the potential effects on threatened and endangered species that may be present in the project area (Appendix C). After review of the Biological Assessment and other relevant data, the USFWS will render a biological opinion. That opinion will state whether, in the view of USFWS, the action is likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or modification of critical habitat. The USFWS has 135 days from initiation of formal consultation to render the biological opinion.

Montana Department of Fish, Wildlife and Parks

The Department of Fish, Wildlife and Parks administers the Stream Preservation Act, and cooperates with the Department of Health and Environmental Sciences in water quality protection matters. Any project proposal that would affect the bed and banks of Libby Creek and its tributaries would require a "124SPA" permit with mitigation provisions. Reconstruction of road drainage structures, habitat improvements, new stream crossings, and the diversion of Little Cherry Creek are examples of activities needing a permit from the Department.

As the lead agency for management of the fishery resource in Montana, the Department also administers the use, enjoyment and scientific study of the fish in Libby Creek. Fish, Wildlife and Parks approval, and designation of a licensed collector as field supervisor, would be required for monitoring, mitigation, and transplanting of the fish within the project area.

Environmental Protection Agency

The Environmental Protection Agency (EPA) has veto authority under the Clean Water Act for decisions made by the U.S. Army Corps of Engineers on Noranda's 404 permit application. The EPA also has responsibilities under the National Environmental Policy Act and the Clean Air Act to review draft EISs and federal actions potentially affecting the quality of the environment. The EPA evaluates the adequacy of the information in the DEIS and determines the overall environmental impact of the proposed action and various alternatives.

U.S. Army Corps of Engineers

Tailings disposal in Little Cherry Creek would constitute the disposal of dredged or fill materials into the waters of the United States and would require a "404 permit" under Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers is the permitting authority for the discharge of dredged or fill materials into the waters of the United States. Noranda has submitted a "404 permit" application to the Army Corps of Engineers (Noranda Minerals Corp., 1990a). Noranda submitted additional information on wetlands impacts and mitigation in April 1992 (Noranda Minerals Corp., 1992b). The Army Corps of Engineers will document its 404 permit decision in a Record of Decision.

The Army Corps of Engineers and the EPA have developed guidelines to evaluate impacts from dredged or fill disposal activities on waters of the United States and to determine compliance with Section 404 of the Clean Water Act (33 CFR Part 320 and 40 CFR Part 230). The Guidelines require analysis of "practicable" alternatives which would not require disposal of dredged or fill material in waters of the United States, or which would result in less environmental damage. Under the Guidelines, the term "practicable" means "available or capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." The agencies' analysis pursuant to the Guidelines is documented in Chapter 2.

Bonneville Power Administration

The Bonneville Power Administration (BPA) would provide a 230-kV power source on its Libby-Noxon line to a distribution utility. The BPA is prohibited by law from serving the mine load directly. The BPA would design the switching station, communication system, and system protection requirements. The BPA has contributed to the environmental analysis by assessing impacts from the placement of this equipment. Before agreeing to provide a tap for electrical power for Noranda's project, the BPA would prepare a Record of Decision for its part of the project.

State Historic Preservation Office

The State Historic Preservation Office (SHPO) must cooperate with and advise the agencies when potentially significant historical, archaeological, or other cultural resources could be affected by the Montanore Project. Under the National Historic Preservation Act, the SHPO provides federal agencies with site value recommendations for cultural resources eligible for the National Register for Historic Places. During mine construction and operation, the agencies would oversee compliance with historic preservation and monitoring plans.

Hard Rock Mining Impact Board

In 1981, the Montana legislature enacted the Hard Rock Mining Impact Act to assist local governments in handling financial impacts caused by large-scale mineral development projects. The legislature recognized that a new mineral development may result in the need for local governments to provide additional services and facilities before mine-related revenues become available. The resulting costs can create a fiscal burden for local taxpayers. The legislature also recognized that some affected local government units may lack jurisdiction to tax a new development. The Hard Rock Mining Impact Board, part of the Montana Department of Commerce, oversees an established process for identifying and mitigating fiscal impacts to local governments. The Board also acts as "referee" in disputes between local governments and project developers.

Noranda submitted a Hard Rock Mining Impact Plan in December, 1990 (Noranda Minerals Corp., 1990b). In the plan, Noranda identified estimated increased public-sector costs attributable to the Montanore Project. Noranda must pay, according to a specified schedule, all increased capital and net operating costs to local governments. A public meeting on the Impact Plan was held in Libby in January,

1991. After an appeal challenging the terms of the Impact Plan was initiated by Sanders County, the hard Rock Mining Impact Board issued a ruling which changes some of the terms of the Plan as prepared by Noranda (see Chapter 4, *Socioeconomics*). Noranda revised the Impact Plan to reflect the Board's order, and the Board approved the plan in April 1992. The Board's decision currently is being contested by Lincoln County in court.

A DSL operating permit may be suspended for noncompliance with the impact mitigation plan. By mutual agreement, Noranda and affected local government units may amend an approved impact plan at any time by petitioning the Board. Either party may also petition to amend the plan under conditions established in the plan, or, if within two years after commercial production begins, the plan is materially inaccurate because of errors in impact assessment. If a local government unit not included in the plan believes that it should have been, it may petition the Board to amend the impact plan.

Lincoln Conservation District

Any mining disturbance occurring within the normal high water level of streams outside of KNF boundaries would require the approval of the Lincoln Conservation District. This approval would constitute a "310 permit" under the Natural Streambed and Land Preservation Act. Prior to granting approval, the District would consult with the KNF and the Montana Department of Fish, Wildlife and Parks.

AGENCIES DECISIONS

Prior to construction and operation of the Montanore Project, Noranda must obtain the approval from numerous federal and state agencies. Approval of the project by the individual agencies would necessitate the issuance of permits, licenses, and approvals shown in Table 1-1.

Sequencing of Agency Decisions

The DSL will be the initial agency to issue a decision; it will decide on Noranda's mine permit application. The DSL's decision will be conditional, however, on the decision by the Board of Health and Environmental Sciences. The Board of Health and Environmental Sciences will decide on Noranda's water quality petition concurrently with the Board of Natural Resources and Conservation's hearing process on Noranda's transmission line application. The KNF will decide on Noranda's project proposal after decisions by the Board of Natural Resources and Conservation and by the Board of Health and Environmental Sciences and following consultation with the U.S. Fish and Wildlife Service on the Biological Assessment.

Federal Agency Permit Denial

No authority exists for the Forest Service to deny a Plan of Operations. A Plan of Operations, however, must meet the purpose of the Forest Service locatable mineral regulations as described in 36 CFR 228 Subpart A. These regulations state in part that all operations shall be conducted, where feasible, to minimize adverse environmental impacts on National Forest surface resources, including complying with all applicable Federal and State air and water quality standards, and standards for the disposal and treatment of solid wastes. Furthermore, all practical measures must be taken to harmonize operations with scenic values and maintain and protect fisheries and wildlife habitat which may be affected by the operation. The Montanore Project cannot proceed if the U.S. Fish and Wildlife Service decides, in its official opinion, that the project could not be conducted without jeopardizing the continued existence of a threatened or endangered species. The Army Corps of Engineers can deny a 404 permit if the project would result in significant environmental impact or violate provisions of the Clean Water Act. The Bonneville Power Administration can deny approval for the electrical tap if significant

environmental impacts at the tap location would occur, or if the interconnected electrical system would not allow adequate service to the mine and existing electrical customers if the mine were approved.

State Agency Permit Denial

Grounds for DSL denial would be a finding that the mining or reclamation plans would violate the laws administered by the DSL (primarily the Metal Mine Reclamation Act), or the water and air quality laws administered by the DHES. Without the approval of the mine by the DSL or the KNF, there would not be the demonstrated showing of need for the transmission line. In such case, the BNRC would likely take action denying the transmission line application. The BNRC may disapprove the transmission line, regardless of actions by other agencies, if it can be shown, based on the hearing record, that the applicable criteria established by the Major Facility Siting Act and implementing rules cannot be reasonably met. Under the Montana Water Quality Act, the BHES can deny Noranda's petition to change the quality of ambient waters if present or anticipated beneficial use of surface or ground water would be precluded, or if an economic and social need for the project is not demonstrated.

PUBLIC PARTICIPATION

The EIS and permitting process has entailed several steps. Public participation has been a key element in preparing this EIS. The first opportunity for public involvement occurred in the beginning of the EIS process when "scoping" was conducted. Scoping was designed to compile a broad list of environmental issues related to the proposed action, and determine their significance. The subsequent analyses documented in the EIS focused on the identified significant issues. The scope of this EIS was established by this process.

On October 10, 1990, a Draft Environmental Impact Statement for the Montanore Project was released for public review and comment. A public meeting was held on October 24, 1990 to explain the contents of the DEIS and gather public comment on the agencies' analysis. The lead agencies decided to prepare a Supplemental DEIS after reviewing public and agency comments submitted on the DEIS. The agencies issued the Supplement on November 8, 1991 for public comment. A public meeting and open house was held on December 9, 1991 to solicit public comment on the supplement. Following a review of the public comments on the Supplemental DEIS, the agencies decided to proceed with issuing this Final EIS. This FEIS integrates the analysis documented in the Supplemental DEIS with that contained in the DEIS. Aspects of the analysis contained in either the DEIS or the Supplemental DEIS have been modified to reflect comments received from the public. The analysis documented in this FEIS adequately portrays the likely environmental consequences of the proposed action and reasonable alternatives. Volume 2 of the FEIS discusses public participation, and agency consultation and coordination in greater detail.

2

PROPOSED ACTION, ALTERNATIVES & REASONABLY FORESEEABLE ACTIVITIES

THIS chapter summarizes the proposed action—the Montanore Project, a silver-copper mine, mill, tailings storage facility and transmission line. Reasonable alternatives to the proposed action, including the no-action alternative, are also described. The first section of this chapter, *Development of Alternatives*, describes how the agencies developed alternatives described and analyzed in this EIS. The next seven sections describe Noranda's project proposal and six alternatives, including the "no action" or permit denial alternative. Alternatives dismissed from detailed analysis in this EIS are described in the next section, *Alternatives Considered but Dismissed in this EIS*. The final section, *Reasonably Foreseeable Activities*, discusses the reasonably foreseeable future activities included in the cumulative impact assessment. These include the Rock Creek Project, a silver-copper mine proposed by ASARCO, Inc., road closures, timber harvest and other activities. Two other types of development—a ski area and other mineral activity—also are described in this section. Subsequent chapters of this EIS discuss the existing environment which might be affected by the alternatives, and the direct, indirect and cumulative impacts of Noranda's proposal coupled with past, present and reasonably foreseeable future activities.

DEVELOPMENT OF ALTERNATIVES

In an EIS, the agencies are required to evaluate the environmental effects of the proposed action and reasonable alternatives to the proposed action. In an EIS, the agencies must consider the *no action* alternative and the *proposed action*—

> *No action*—Under this alternative, Noranda would not construct the Montanore Project. The agencies would not grant required permits, and approval for the operation would be denied. The no action alternative provides a baseline for estimating the effects of other alternatives.
>
> *Proposed action*—Noranda would construct, operate, monitor, and reclaim the Montanore Project as proposed in the plan of operation and

applications. The agencies would issue the necessary permits and approvals.

Other alternatives consist of reasonable modifications to various elements of the proposal. These alternatives fall into two main categories—those that modify the *location of facilities* and those that modify or change the *methods and procedures* employed in the operation.

Location of facilities. Alternative locations for each of the facilities were considered in response to issues and concerns associated with the proposed facility locations. Alternative locations for the mine portal(s), plant site, tailings impoundment, and corridors which contain roads, powerline, or the tailings pipeline were considered. As discussed in subsequent sections of this chapter, only alternative locations for the transmission line were developed and analyzed in detail in this final EIS. The agencies believe Noranda's proposed locations for other facilities would be the most reasonable locations.

Methods and procedures. Noranda has proposed discharge of excess water in land application disposal areas and collection of tailings impoundment seepage with a relief well system. Alternative water treatment methods and seepage collection techniques have been considered in response to the issues and concerns associated with the proposed operating or construction plans. Alternative methods for construction of the transmission line were developed. Alternatives or additions to Noranda's reclamation and monitoring plans also have been developed.

Through a series of pubic and internal meetings, the agencies determined the environmental issues that would be used as criteria in identifying and evaluating the alternatives. Six significant issues, defined as indicators of potential significant adverse effects, emerged from the scoping process and agencies' discussions. The effects have the potential to be severe or long-lasting, could affect a large area or could occur frequently when a resource's quantity, quality, fragility, or uniqueness are considered. These issues are—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quantity and quality of water resources and effects on aquatic life.

A number of alternatives were considered during the scoping process. Alternatives other than the proposed action alternative and the no action alternative were then developed in response to identified environmental issues. The intent of these alternatives was to minimize potential negative environmental impacts through modification of planned operations or relocation of any or all of the proposed project facilities. Nine alternatives are described in the following sections and evaluated in detail in the EIS including—

- Alternative 1–Noranda's mine and transmission line proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3A–full lining of the impoundment and mechanical treatment of all excess water;
- Alternative 3B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Alternative 3C–alternative water management/land application treatment of all excess water.
- Alternative 4–Modified Miller Creek alternative transmission line routing;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action.

Alternative 1 is Noranda's mine and transmission line proposal as described in the plan of operation and applications submitted to the agencies. Alternative 2 consists of the agencies' proposed modifications to Noranda's mine proposal. These modifications are intended to reduce or avoid the possible impacts identified during the agencies' analysis of the proposal. The six significant issues were considered in developing proposed modifications.

Alternative 3 includes three different water management/treatment options that would reduce potential effects to water quality. Issue 6—effects on water resources and aquatic life—is the primary issue addressed by this alternative. Most of the mitigations and modifications described under Alternative 2 would be incorporated into Alternative 3. If full lining of the impoundment is required, a system designed to reduce seepage, such as gravel drains, would not be constructed.

The DEIS documents the analysis of a varied width transmission line route drawn along a tentative alignment for each transmission line alternative. Following publication of the DEIS, Noranda submitted additional information on "centerlines" or a 500-foot corridor in which the transmission line would be constructed. This information pertained to wetlands, old growth habitat, adjustments to the reference centerlines that were analyzed in the DEIS, and construction of the Sedlak Park substation and Barren Peak microwave site. Figure 2-1 shows the various centerline segments considered within the routes identified in the DEIS.

Centerline adjustments considered within the routes take advantage of terrain and existing access roads to improve siting in problem areas identified in the DEIS. The DNRC and the KNF evaluated the various adjustments and selected a centerline alignment within each route to balance physical siting constraints, potential environmental impacts, and costs.

Line location along any route and centerline would incorporate the mitigating measures identified in the FEIS, and additional mitigation measures found to be necessary following more detailed field analysis. The agencies recommend the use of a helicopter rather than a crawler tractor during stringing of the line, and realignments near the Libby Creek Recreation Gold Panning Area. These changes are discussed as part of Alternative 4, Modified Miller Creek. Modifications of the route alternatives were documented in the Supplemental DEIS and have been included in the Final EIS for Alternatives 4, 5 and 6. The combined route and centerline analysis for Alternatives 4, 5 and 6 will form the basis of the agencies' recommendation to the Board as documented in Chapter 5.

Alternative 4 consists of modifications in the transmission line location and construction methods proposed by Noranda. A route adjustment in the area of Howard Lake has been proposed by the agencies. The modified route would avoid crossing portions of the Libby Creek Recreation Gold Panning Area. The DNRC has proposed modifying the Environmental Specifications (Appendix F) to incorporate additional detailed measures to control potential for erosion and sedimentation. Additional review time during final design also would allow the agencies to apply appropriate site specific mitigation measures where necessary prior to construction. Proposed modifications to line location, and construction methods would result in less clearing and surface disturbance, in response to Issues 1, 2 and 6.

Alternatives 5 and 6 respond to Issue 1 concerning wildlife impacts, and Issue 2 concerning recreational effects. These alternatives would reduce or avoid impacts to developed recreation areas and have less impact on big game habitat. They would incorporate changes proposed by the DNRC to the environmental specifications and incorporate other appropriate mitigation measures identified under Alternative 4.

Analysis of Alternative 7, the no action alternative or permit denial, is required by MEPA and NEPA. Existing baseline conditions and trends would be maintained. Fiscal effects, such as increased direct

and indirect revenues to workers and government units, would not occur under Alternative 7.

ALTERNATIVE 1—NORANDA'S PROPOSAL

Development of the Montanore Project would require disturbing six areas during construction of project facilities (Table 2-1, Figure 2-2). The mill and mine production adits would be in upper Ramsey Creek, about one-half mile from the Cabinet Mountains Wilderness boundary. An additional adit on private land along Libby Creek would be used for ventilation. The adit was partially constructed under an exploration permit issued by the DSL in 1989. Noranda ceased construction of the adit in November 1991 in response to water quality concerns. A tailings impoundment is proposed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two land application disposal (LAD) areas are proposed to allow for discharge of excess water. Waste rock would be stored temporarily at one land application disposal area, and at the Libby Creek adit area. Permit area boundaries would be establish around each of these facilities (Figure 2-3). A transmission line to supply electrical power would be constructed from Sedlak Park to the Ramsey Creek plant site. Noranda would upgrade the Bear Creek Road (#278) and two other KNF roads (#2317 and #4781). Noranda's proposed construction, operation and reclamation plans are described in greater detail in the following sections.

Mine Plan

Noranda would develop an underground mine producing 20,000 tons of ore daily, or 7 million tons per year. A 230-kV transmission line would supply power. Current ore reserves are estimated at about 135 million tons at an average grade of 1.93 ounces of silver per ton and 0.74 percent (~15 pounds per ton) copper (Noranda Minerals Corp., 1991a). These reserve estimates are based on a limited number of drill holes. The deposit has not been fully delineated and likely extends further north than the available drilling information. Considering an expected ore extraction of 60 to 70 percent, waste rock dilution, and initial production rates, the mine is anticipated to have a production life of 16 years.

Table 2-1. Surface area disturbance associated with the Montanore Project.

Facility	Disturbed area (acres)	Permit area (acres)
Libby Creek adit area	18.7	219.4†
Transmission line, substation and roads§	—	—
Ramsey Creek plant site	44.9	185.2
Waste rock storage area and land application disposal area No. 1¶	58.0	246.0
Land application disposal area No. 2¶	20.0	225.7
Access road—Ramsey Creek plant site to tailings impoundment	99.4	214.9
Temporary access road—Libby Creek adit site to Ramsey Creek Road	34.4	93.8
Access road—Libby Creek adit site to tailings impoundment	0.0	0.0
Access road—U.S. 2 to tailings impoundment	22.0	0.0
Little Cherry Creek tailings impoundment and borrow areas	993.7	2,458.8
Total	1,272.4	3,424.4

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-18, revised 1991.

†Permitted under a DSL exploration permit; not included in total.

§Transmission line construction (Alternatives 1, 4, 5, and 6) would require between 221 acres and 246 acres of tree clearing, and between 42 acres and 50 acres of new ground disturbance, depending on alternative. The proposed substation at Sedlak Park would disturb about 2.5 acres.

¶Disturbance shown for land application disposal areas does not include area used for land application of excess water (up to 221 acres).

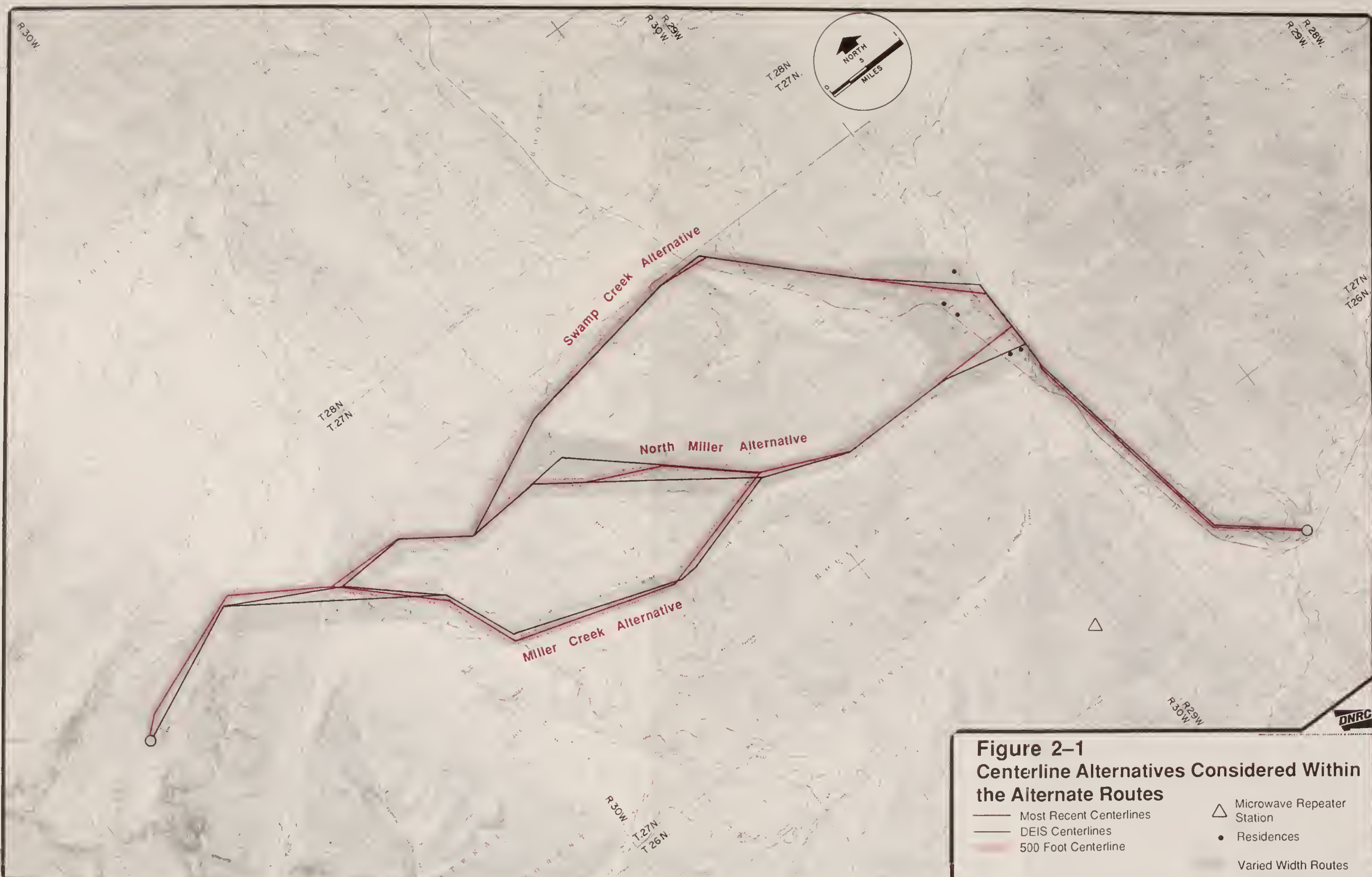


Figure 2–1
Centerline Alternatives Considered Within the Alternate Routes

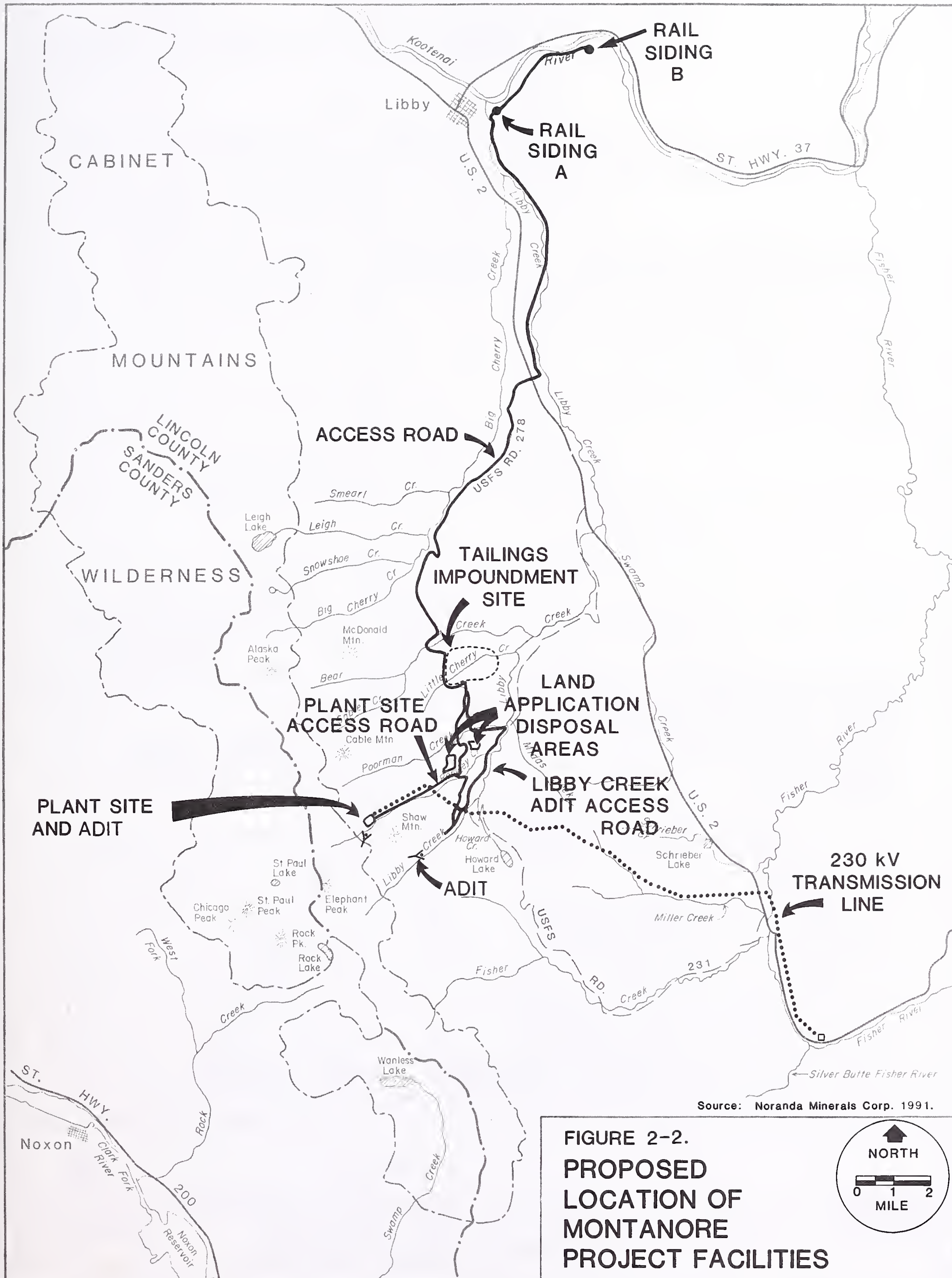


FIGURE 2-2.
PROPOSED LOCATION OF MONTANORE PROJECT FACILITIES

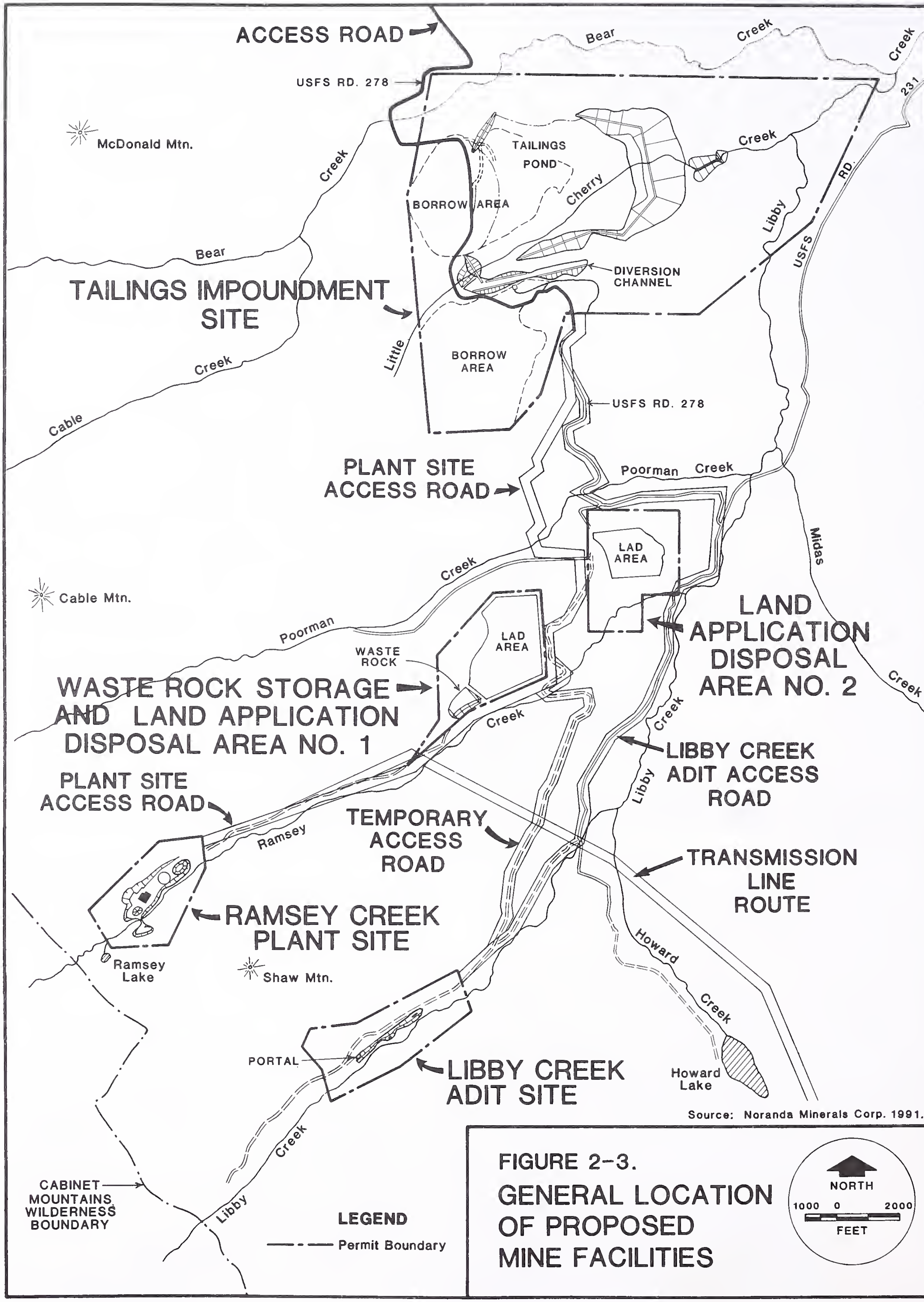


FIGURE 2-3.
GENERAL LOCATION OF PROPOSED MINE FACILITIES

Preproduction development. Preproduction development would include completing the Libby Creek adit, conducting underground geotechnical investigations, and completing the Ramsey Creek adits. The Ramsey Creek adits would be two parallel adits directly southwest of the plant site for a distance of about 13,000 feet (Figure 2-4). The adits would include a main conveyor adit and a parallel main ventilation intake adit. The Ramsey Creek adits would terminate at an underground primary crusher.

Adit portals are proposed outside the wilderness boundary. Portal patios would be constructed by cutting into the sideslope, creating a vertical face for adit construction. Adit size is dictated by ventilation requirements and mining equipment dimensions, with each adit estimated at about 25 feet wide by 25 feet high.

An additional 18,000-foot ventilation adit on a private land site along Libby Creek would be used. Noranda started adit construction in 1989 under an exploration permit issued by the DSL. The purpose of the Libby Creek adit is to provide access to the ore body and to conduct geotechnical and geochemical investigations. The adit originates at about 4,000 feet elevation and slopes downward five percent over its 18,000-foot length. Before starting adit construction, Noranda salvaged and stockpiled suitable topsoil. Additional facilities at the Libby Creek site include a waste rock storage area, a land application disposal area, diversion ditches and settling ponds, and mine support buildings (Figure 2-5).

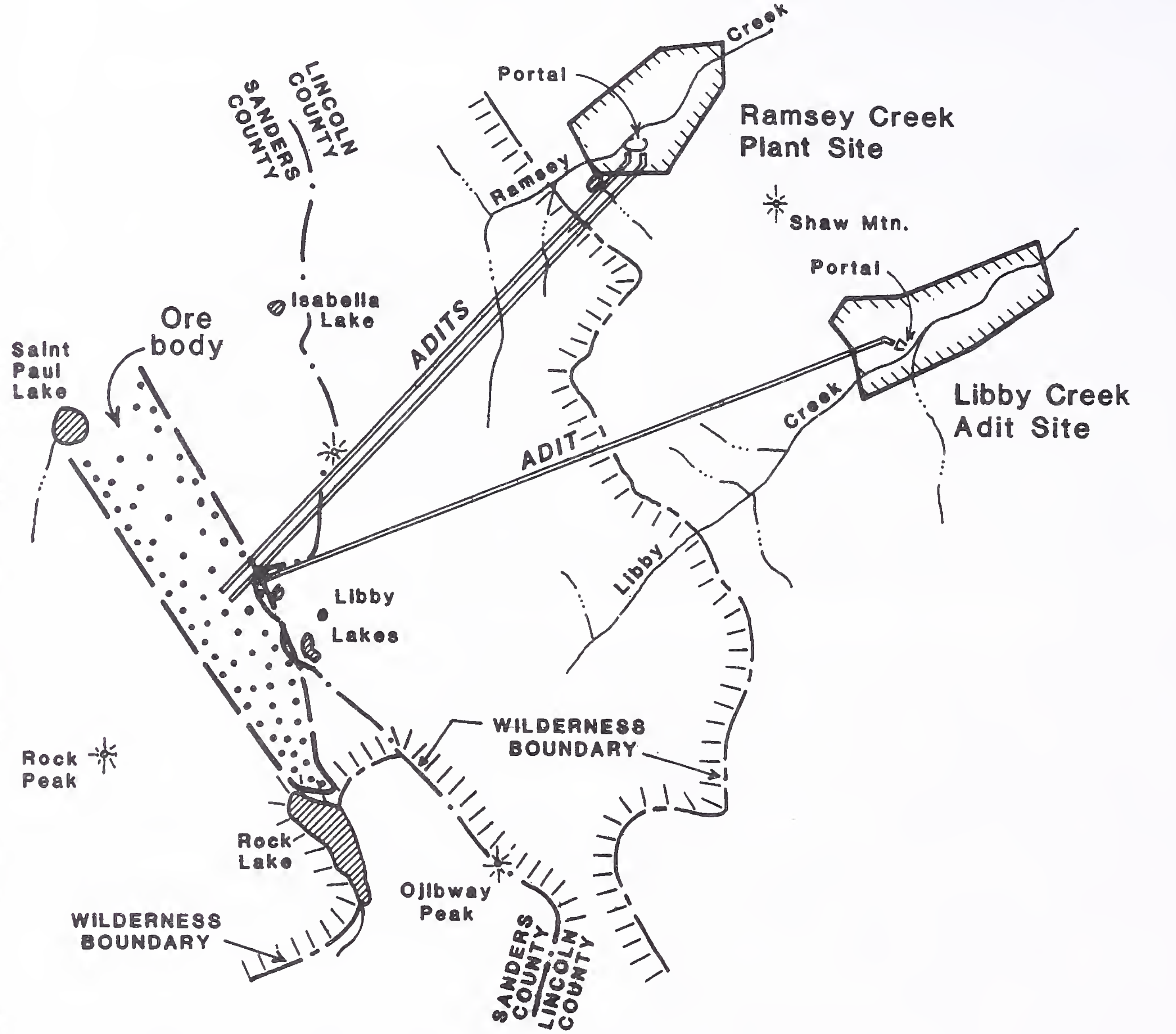
Noranda ceased construction of the Libby Creek adit in November, 1991 in response to water quality concerns. Increased nitrate concentrations were detected in upper Libby Creek during water quality monitoring required as part of the exploration license. Nitrate concentrations exceeded existing concentrations in upper Libby Creek. Under Montana law, changes in existing water quality cannot occur without an authorization allowing a change in ambient water quality from the Board of Health and Environmental Sciences. Chapter 4, *Surface Water Quality*, discusses water quality associated with the Libby Creek adit in greater detail. About 4,000 feet of the Libby Creek adit remains to be completed.

Other preproduction underground development would include excavation of the crusher station and related ore and waste rock bins, and development of main mining benches, haulage drifts, ore and waste passes. On-site propane generators would power electric fans for ventilation to underground activities until the transmission line was built and operating. The transmission line, plant site, and initial tailings impoundment construction would also occur prior to production.

Ore body characteristics. The ore body is composed of two nearly parallel horizons that range from 14 to 140 feet thick and average 35 feet each. The two ore horizons are separated by waste rock that ranges up to 200 feet thick. Overburden thickness ranges from 0 feet at the ore outcrop near the north end of Rock Lake to more than 3,800 feet near St. Paul Lake. The ore body slopes from 5° to 50° to the northwest.

The ore consists of quartzite, silty quartzite, and siltite of the lower Revett Formation. Noranda has conducted rock strength tests on ore collected from drill cores; Table 2-2 summarizes laboratory results. Rock strength generally decreases with increases in silt content.

Room-and-pillar design. Conventional methods of drilling, blasting, rock bolting, and mucking would be used for ore extraction. Noranda would use electrical equipment to minimize underground emissions and ventilation needs. A room-and-pillar method would be used for ore extraction. In room-and-pillar mining, some ore is not mined to provide pillar support (Figure 2-6). Noranda's preliminary mine design is based on a rigid pillar approach (Redpath Engineering, Inc., 1991). Three pillar types, based on their location within the deposit, are planned. Standard pillars would be used within the area to be mined; a barrier pillar would be used along the Rock Lake Fault to separate the fault from the



Source: Noranda Minerals Corp. 1989a.

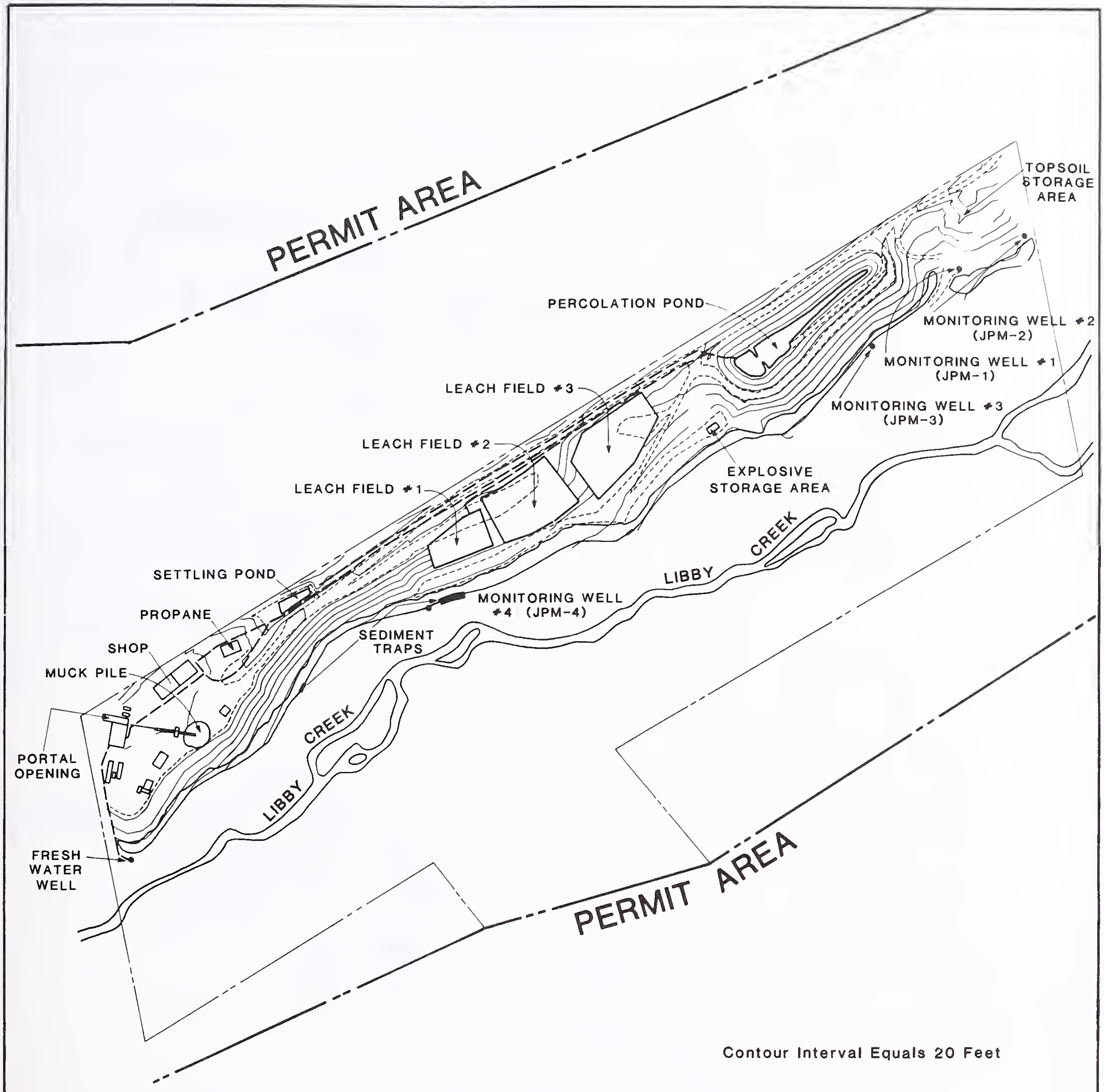
FIGURE 2-4.

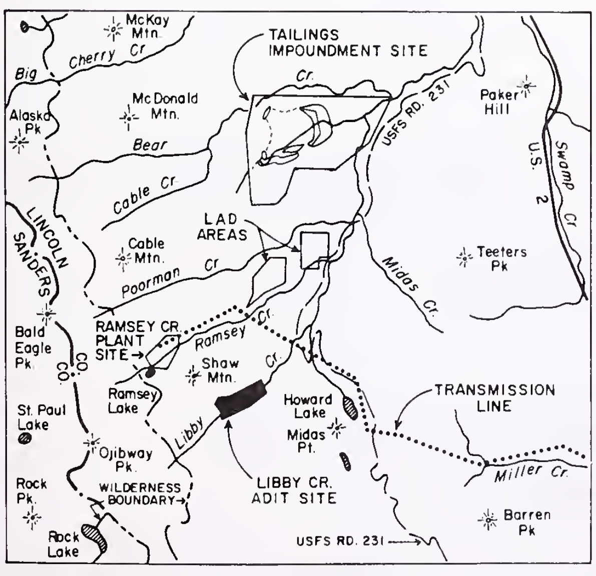
ADIT AND PORTAL LOCATIONS

NORTH

0 4000

FEET





Source: Noranda Minerals Corp. 1989a.

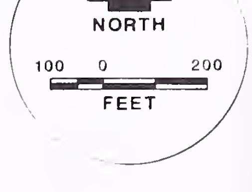
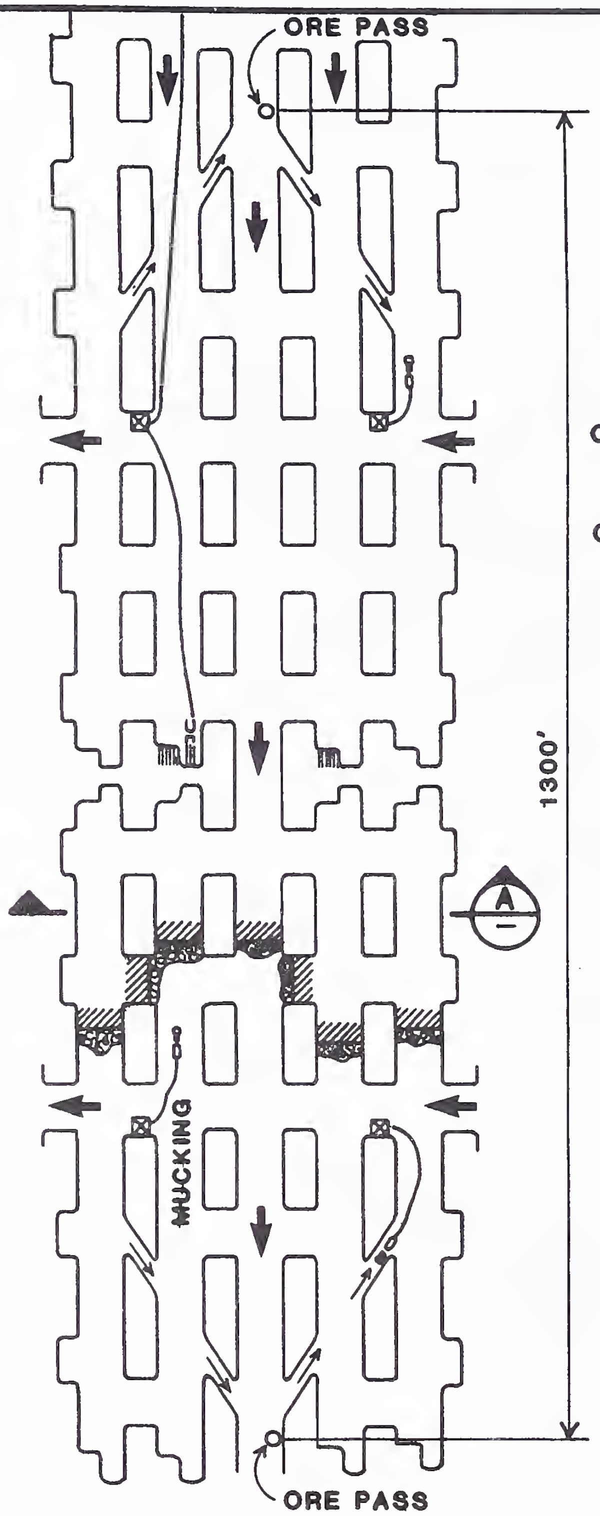


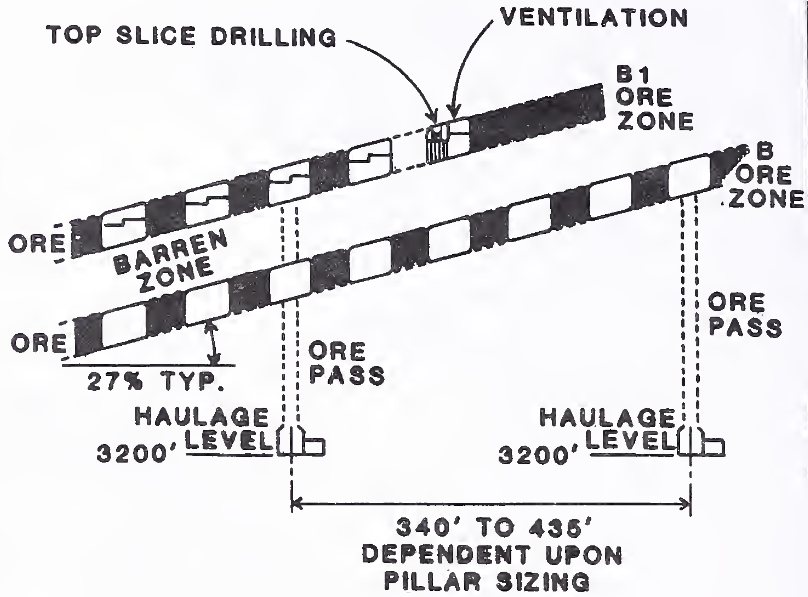
FIGURE 2-5.

LIBBY CREEK ADIT SITE



PLAN VIEW

SCALE: 1" = 200'



CROSS SECTION (A)

SCALE: 1" = 200'

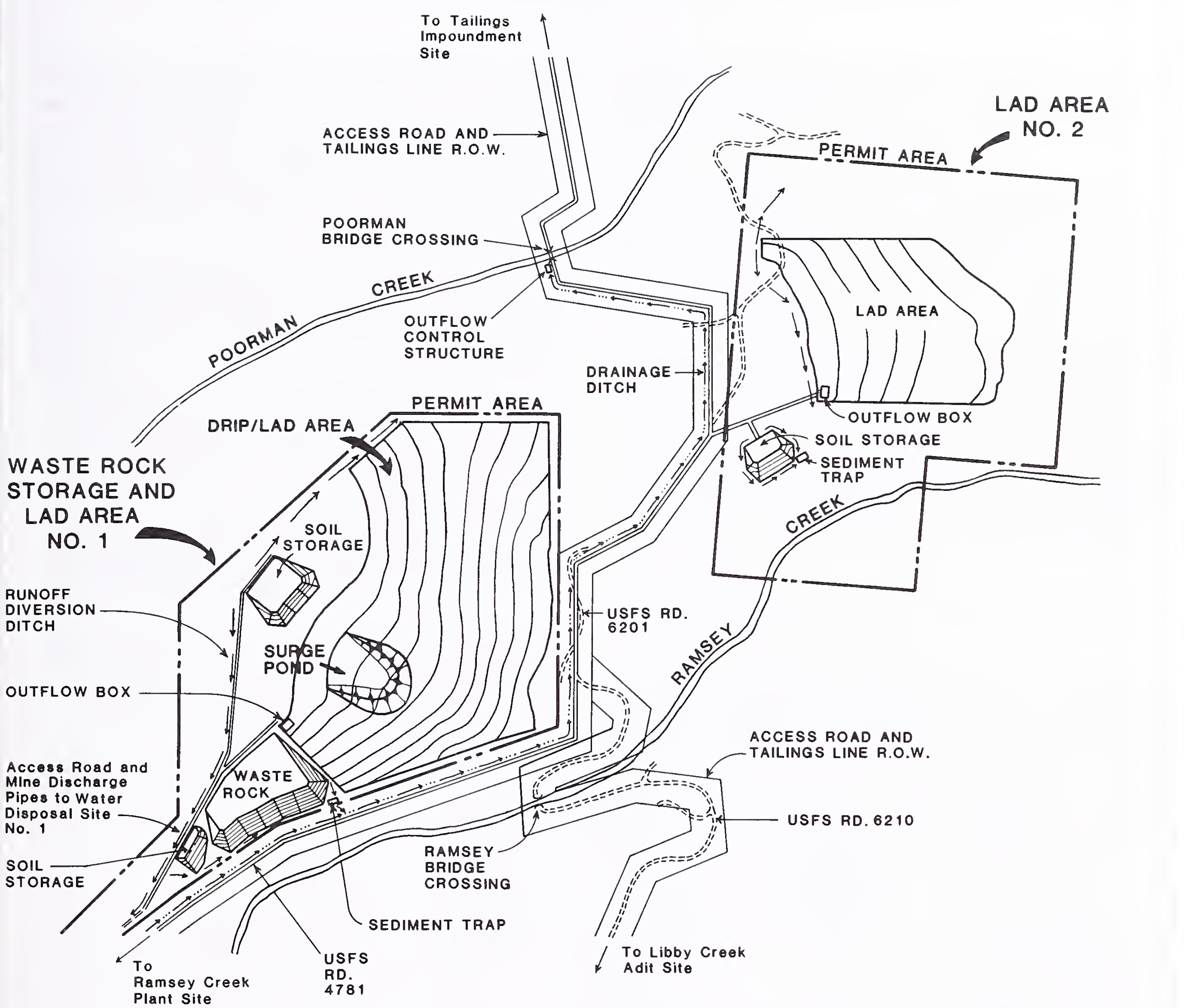
LEGEND

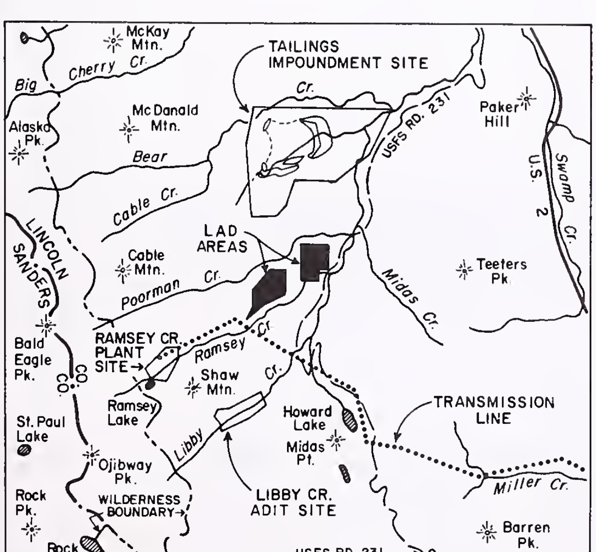
- → INDICATES RAMP @ +15%
- ➡ VENTILATION
- ⊠ POWER CENTER
- ▨ BENCH
- ▯ PILLAR

Source: Noranda Minerals Corp. 1989a.

FIGURE 2-6

ROOM-AND-PILLAR MINING

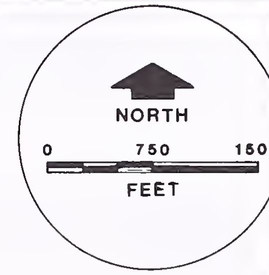




Source: Noranda Minerals Corp. 1989a.

FIGURE 2-7.

WASTE ROCK STORAGE AND LAND APPLICATION DISPOSAL AREAS



mine area; and a surface barrier pillar adjacent to Rock Lake would be used to separate the mine workings from the lake and surface.

Preliminary mine planning has been based on a standard pillar size of 35 feet wide by 80 feet long, laid out in a regular grid basis. A safety factor of 1.3 was used as the pillar design criterion. Average mining height of 32 feet and a panel width (area between pillars) of 45 feet was assumed for initial mining planning. Initial estimates indicate 67 percent of the mineable reserves would be removed. Actual pillar sizes would vary depending on the ore thickness, overburden thickness, local rock quality, and hydrologic conditions. Final pillar design would be developed following evaluation activities planned after completing the Libby Creek adit.

Underground core drilling would be performed before full-scale mine development. The drilling would be used to collect information on geologic structures, ore thicknesses, ore grades, and hydrology. The drilling information would be used to design the pilot drifts (initial mine areas) before production begins. Pilot drifts would be driven through the center of each production panel along the entire width of the ore body. The geology along the pilot drift would be mapped, and the back and footwall would be drilled to determine ore boundaries. Final room-and-pillar design would be completed following pilot drift activities.

Microseismic and conventional monitoring would be used to evaluate long-term stability. Monitoring sensors would be located in operating and abandoned sections of the mine. The sensors would be connected to a continuous monitoring system and would record the size and approximate location of seismic events. Noranda has committed to an ongoing geotechnical program to identify potential subsidence problems prior to their occurrence (Noranda Minerals Corp., March 27, 1991). Noranda would notify the agencies of any conditions that have significant impacts on mine design or that would affect the conclusions of the existing geotechnical evaluation. Noranda would implement changes in the mine design to avoid subsidence or conditions that could lead to catastrophic failure.

Initial mine development would start in the central

Table 2-2. Summary of rock strength properties—lower Revett Formation.

Rock type	Uniaxial compressive strength (psi)	Tensile strength (psi)	Friction angle (deg)	Cohesion (psi)
Quartzite				
Average	53,302	2,202	58.8	7,687
Standard deviation	15,370	379	—	—
# of samples	10	4	5	5
Silty quartzite				
Average	25,709	1,964	47.2	5,520
Standard deviation	8,057	702	—	—
# of samples	21	4	5	5
Siltite				
Average	21,918	—	38.9	4,542
Standard deviation	5,658	—	—	—
# of samples	18	—	5	5

Source: Redpath Engineering Inc. 1991. Appendix A, p. A-14.

section of the deposit. Mining would progress generally toward Rock Lake and take seven or eight years to reach the upper portion of the deposit near Rock Lake. Noranda would stop mining 500 feet from Rock Lake and 100 feet from the Rock Lake fault (Figure 2-8). Before mining closer to these two features, Noranda would conduct hydrologic and geotechnical studies to determine whether closer mining could be safely conducted. These studies would consist of drilling into the fault zone to determine—

- hydraulic conductivities and transmissivities for the fault zone and adjacent transition zones;
- width of the fault and transition zones; and
- water pressures in the fault and transition zones.

Similar studies would be conducted on the Rock Lake barrier pillar prior to mining closer than 500 feet to Rock Lake. These studies would be reviewed by the agencies and approval would be required before Noranda could mine closer.

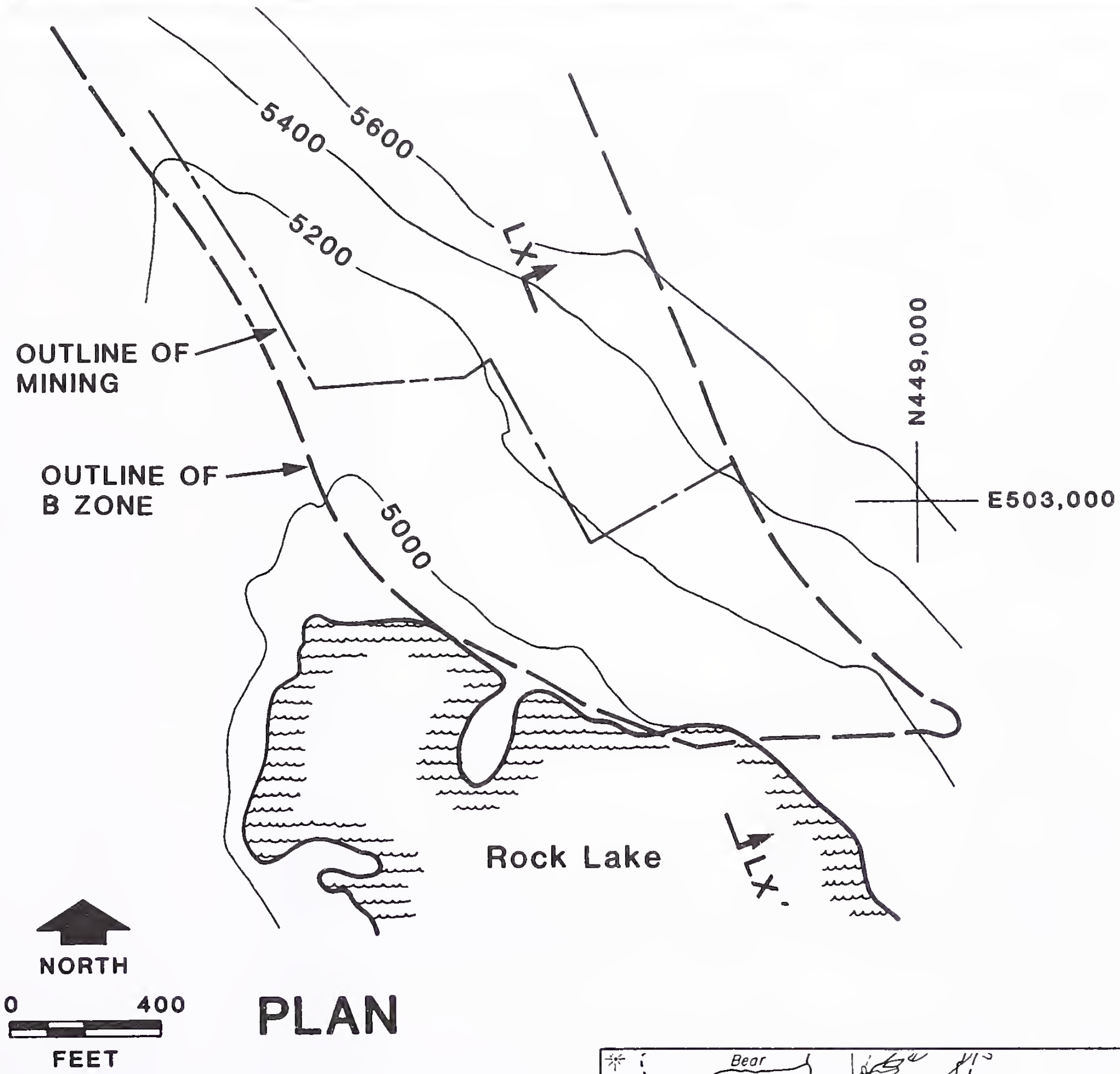
Ore would be hauled from the ore passes to the primary underground crusher using 39-ton electric haul trucks. Crushed ore would be sent to the surface in Ramsey Creek via conveyor belt for further crushing, grinding, and ore recovery.

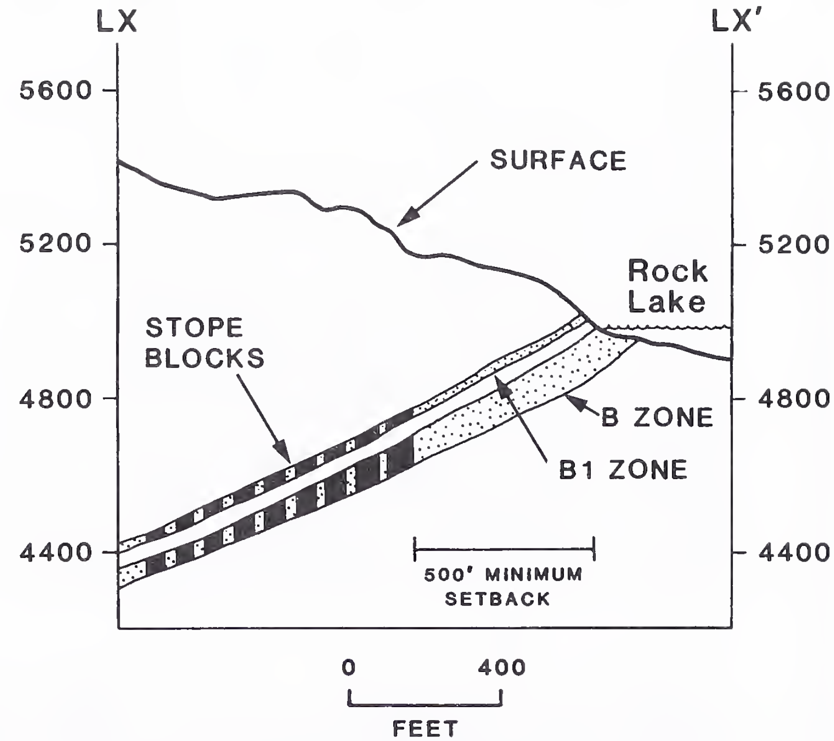
Waste rock. During the project, an estimated 1,766,000 cubic yards of waste rock would be excavated (Table 2-3). Waste rock from adit construction completed to date is stored at the Libby Creek adit site and any additional waste rock from the Libby Creek adit would be at the site or trucked to the tailings impoundment. An additional storage area would be along Ramsey Creek. The flat-

Table 2-3. Waste rock production and storage.

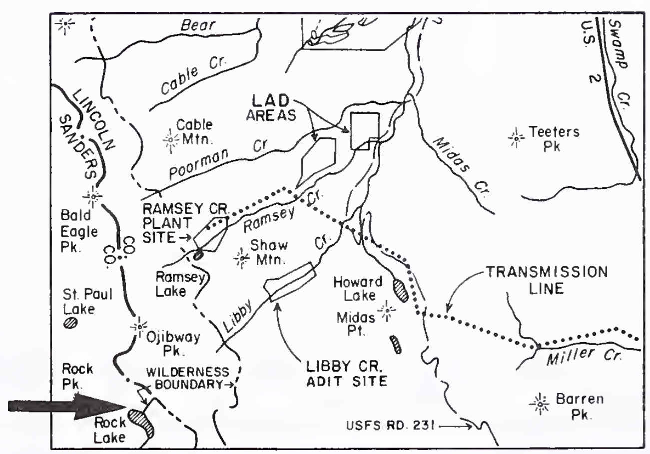
Year	Project stage	Annual production (BCY x 1,000)[†]	Cumulative production (BCY x 1,000)[†]	Required vol. for dam construction (CY x 1,000)[§]	Rock designation
1	Evaluation	123	123	0	Crushed
2		123	246	0	Crushed
3	Preproduction	344	590	425	Run of mine
4	development	344	934	(Starter stage)	Run of mine
5	Initial	64	998		Run of mine
6	production	64	1,062		Run of mine
7	Full	64	1,126		Run of mine
8	Production	64	1,190		Run of mine
9		64	1,254		Run of mine
10		64	1,318	1,077	Stored in mine
11		64	1,382	(Operation stage)	Stored in mine
12		64	1,446		Stored in mine
13		64	1,510		Stored in mine
14		64	1,574		Stored in mine
15		64	1,638		Stored in mine
16		64	1,702		Stored in mine
17		64	1,766		Stored in mine

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-29-a; revised May 17, 1991—on file with the agencies.
[†]"BCY or bank cubic yards" with an estimated density of 167 lbs./cu.ft.
[§]Yardage indicated for dam construction is measured in "placed compacted yards" with an estimated density of 140 lbs./cu.ft.





SECTION LX-LX'



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-8.

RELATIONSHIP OF ORE BODY TO ROCK LAKE

topped rock pile would reach a maximum height of about 140 feet. All waste rock produced during mining (as opposed to during adit construction) would be placed underground in previously mined areas or sent to the surface for construction of surface facilities, primarily the plant site and the tailings impoundment dam. All waste rock would be removed from the stockpile by the end of operations.

Noranda would use USFS Road #6210 (between Ramsey Creek and Libby Creek) during the construction period to haul waste rock from the Libby Creek adit site to the tailings impoundment or plant site. A temporary bridge would be constructed across Ramsey Creek to provide access to the road from the Ramsey Creek road. Noranda would close the road and remove the bridge after all waste rock has been removed from the Libby Creek adit site at the end of the construction period.

Ore Processing and Shipment

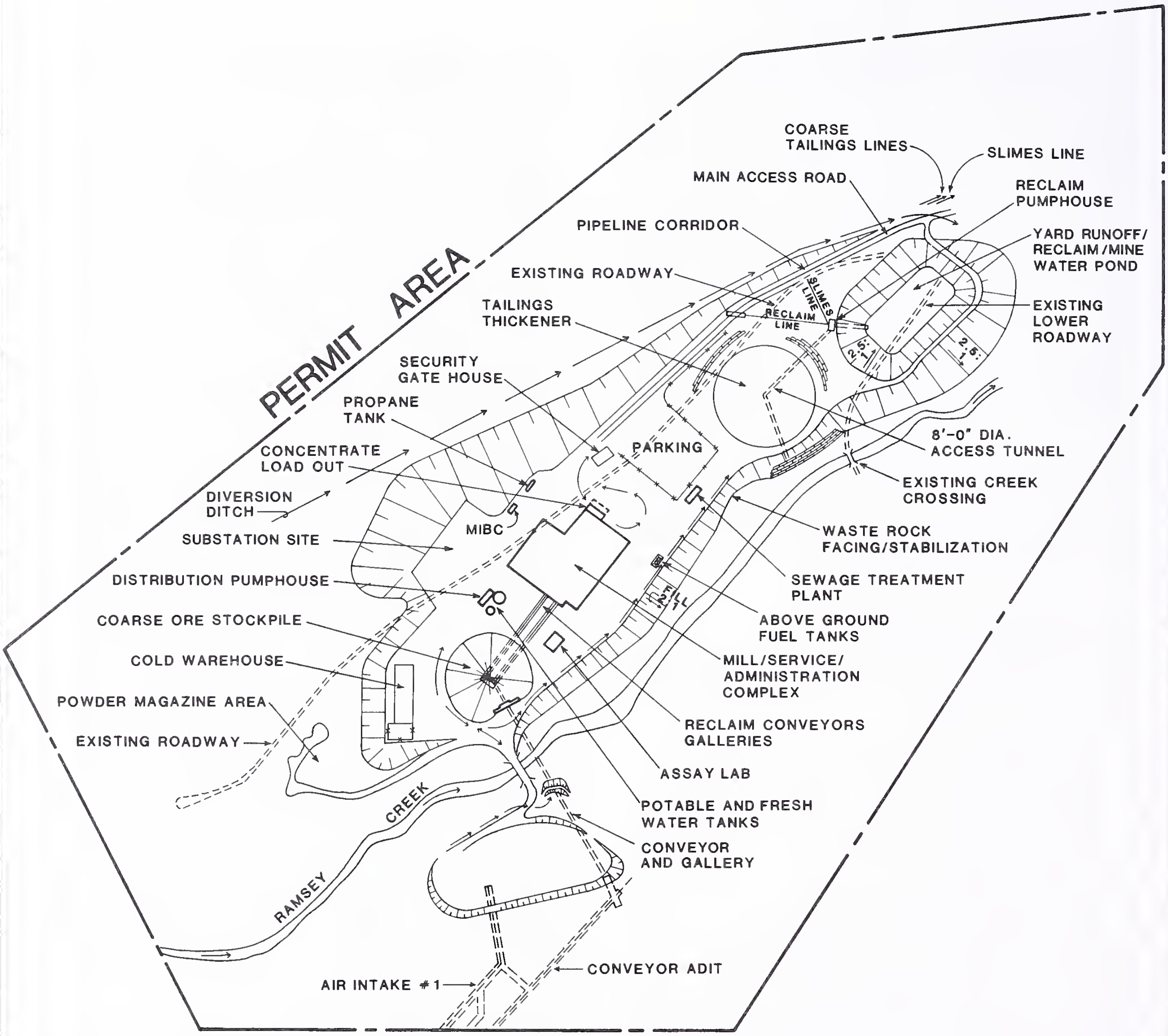
The mill would be constructed adjacent to Ramsey Creek and consist of—

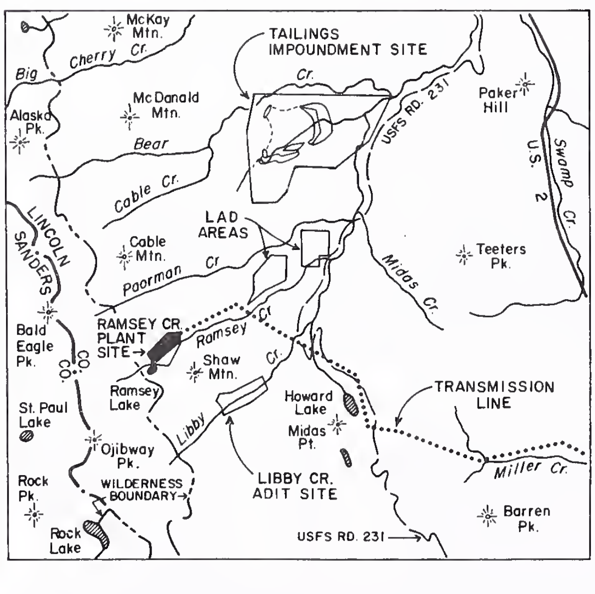
- a mill concentrator;
- a tailings thickener;
- drainage sumps;
- attendant pumps;
- slurry and water lines;
- an office building and a parking area, and
- changing house, and shop warehouse (Figure 2-9).

Ore processing. The mill would operate 7 days a week, 350 days a year for a total processing capacity of 7 million tons per year. The milling process would involve five major steps—crushing, grinding, flotation, concentrate dewatering, and tailings storage. Figure 2-10 illustrates the steps used in ore processing. Crushing, grinding, and flotation would produce tailings, and a single concentrate containing both copper and silver. Chemical reagents added during the flotation process would separate concentrated metals from the tailings (Table 2-4). Some reagents would be disposed in the tailings impoundment and some would remain in the ore concentrate.

Montanore ore would be processed into concentrate using a process known as froth flotation. Froth flotation has been used for many years as a method of metal concentration. In this process, finely ground ore is mixed in a slurry with water and various chemicals (reagents) and aerated in a vessel—or typically a series of vessels—known as "flotation cells." Under suitably controlled conditions, desired minerals such as silver or copper ore, are selectively attached to air bubbles which form a froth on the surface that can be skimmed and collected. Processing some ores using froth flotation requires adding lime or other chemicals to control the pH of the slurry. Both bench scale testing of Montanore Project ore and evaluating the ASARCO Troy milling process (which processes an ore similar to Montanore ore) indicate that the mill process would operate at a near neutral pH. Noranda, therefore, does not anticipate the need for the addition of lime or other chemicals; process chemicals may be required periodically, however, for testing, pH modification, or cleaning of the flotation and other process circuits in the mill. Particles in the froth are separated from the liquid fraction to produce, in the case of the Montanore Project, a copper-silver concentrate. The concentrate is the final economic product of the milling process. What remains of the ore after metals removal is disposed as tailings (see *Tailings Storage* section).

Table 2-4 lists the reagents proposed for use in processing Montanore ore. Material safety data sheets for these reagents are provided in Appendix I. Aerofroth® 70 Frother is manufactured by the American Cyanamid Company. A frother is used to promote the formation of air bubbles. This product contains an alcohol referred to as MIBC (methyl isobutyl carbinol). About 385 lbs/day would be used at an ore production rate of 20,000 TPD. Aero® 350 Xanthate would be used as a "collector" or "promoter" in the flotation process. This product,

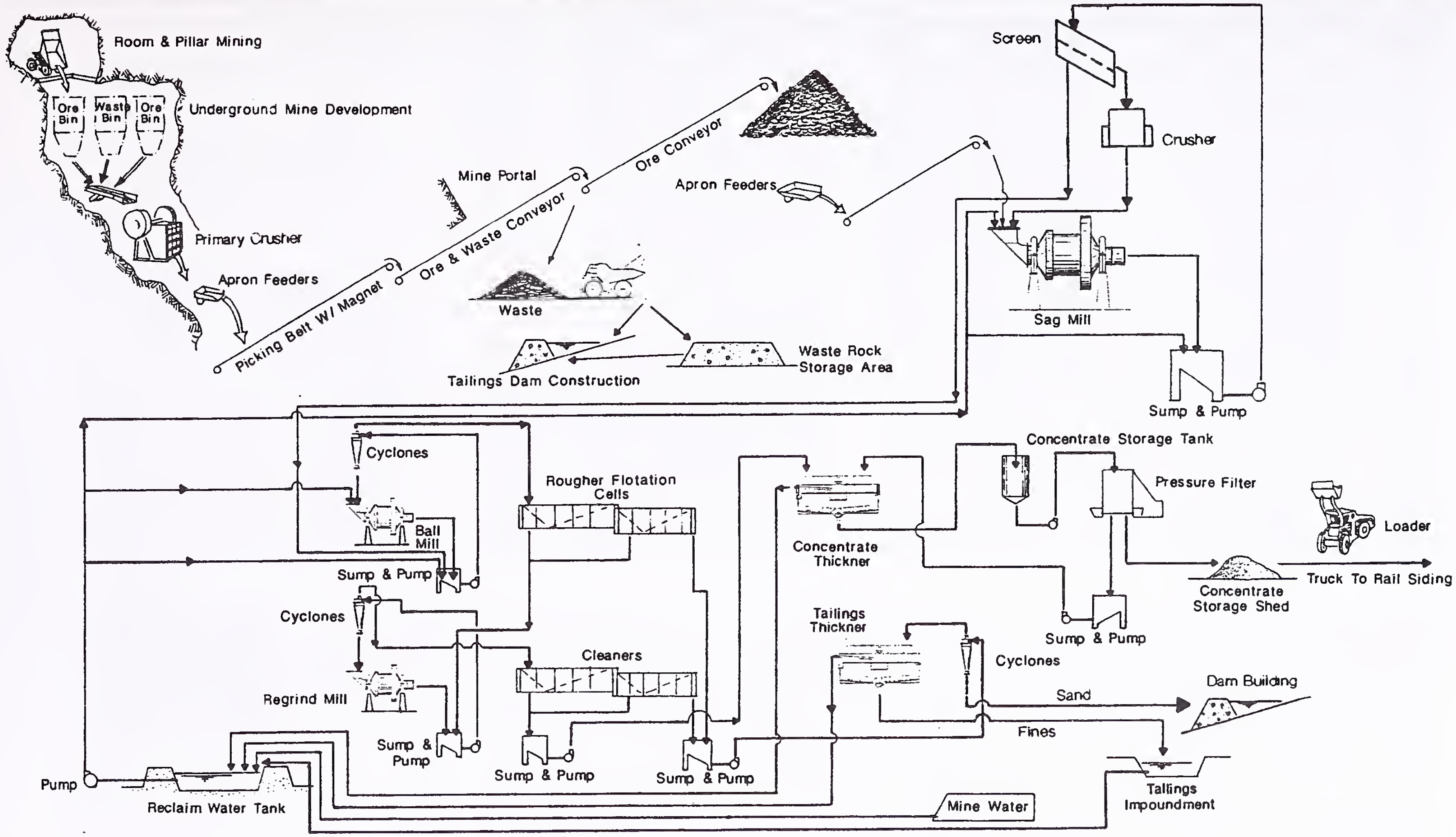




Source: Noranda Minerals Corp. 1989a.

FIGURE 2-9.

RAMSEY CREEK PLANT SITE



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-10

MINING AND MILLING FLOWSHEET

also manufactured by American Cyanamid, is a mixture of several ingredients, primarily potassium amyl xanthate. For Montanore ore, about 767 pounds per day of xanthate would be used at an ore production rate of 20,000 tons per day. American Cyanamid's Magnifloc® 491C flocculant would be used at the same rate (385 lbs/day) as MIBC. Magnifloc® 491C is a cationic polyacrylamide, and functions in the process to promote the settling of solids in liquid suspension. Similar reagent formulations are produced by other manufacturers and may be used by Noranda in place of the products from American Cyanamid Company.

Concentrate shipment. Concentrates leaving the flotation process would be pumped to a 60-foot diameter concentrate thickener where a portion of water would be removed for reuse in the mill. After further dewatering, concentrates would be deposited in a shed and then loaded into haul trucks by a front-end loader. About 420 tons of concentrate would be trucked daily to a railroad siding near Libby via USFS Road 278 and a haul road owned by Champion International Corp.

Noranda is currently considering two possible load-out locations where the copper-silver concentrate from the mill would be trucked and then loaded onto railcars for shipment to a smelter (Figure 2-2). One location is near the confluence of Libby Creek and the Kootenai River. This site would require rail siding construction in a privately-owned pasture. An alternate site, about five miles east of the first location, would use an existing W.R. Grace facility.

Gasoline and diesel fuel would be stored at the plant site in two above-ground storage tanks. A containment berm would be built around the tanks. Noranda has prepared a spill prevention control and containment plan (see subsequent *Waste Management* section).

Tailings Storage

Tailings would be separated at the mill into coarse-textured (sand) and fine-textured (slime) fractions. The sands and water would flow by gravity through a 10-inch, high-density, polyethylene pipe to the tailings impoundment, where they would be used in dam construction. As a backup, an auxiliary coarse tailings line to the impoundment would be constructed.

The slimes would flow to a thickener just east of the plant. Thickener overflow (water) would be diverted to a small surface pond (see *Water Use and Management*). Slimes and water would flow via a 14-inch, high-density, polyethylene pipe to the tailings impoundment for disposal. All lines would be routed in part along the existing road. A new road would be constructed along portions of pipeline that diverge from the existing road.

Noranda has designed a number of measures to prevent or mitigate ruptures in the tailings pipelines.

Table 2-4. Description of reagents.

Reagent	Purpose	Addition point	Consumption: Pounds per ton ore	Consumption: Pounds per year	Storage
Potassium Amyl Xanthate	Collector	Ball mills Regrind mills Flotation cells	.04	280,000	250 lb. drums
MIBC	Frother	Flotation cells	.02	140,000	9,000 gal. tank
Magnifloc 491 C	Flocculant	Concentrate and tailings thickener	.02	140,000	50 lb. bags

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-54.

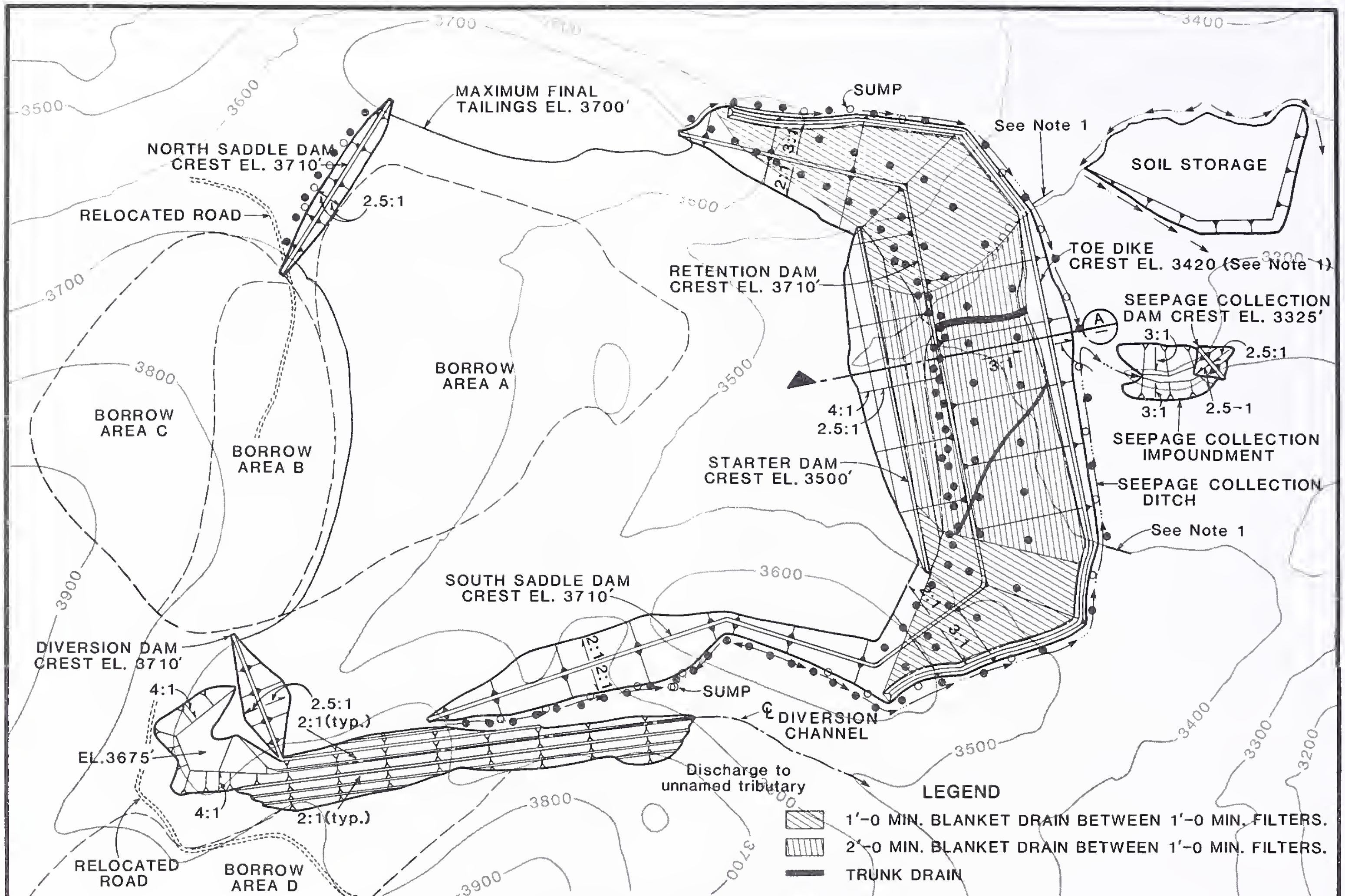
Noranda would construct a second (backup) sand line to use in the event that the first line becomes significantly eroded. An automated leakage sensing system would continuously monitor line operation. If the system detects a leak, the mill and tailings transfer would shut down. The pipelines between the mill and the tailings impoundment would be visually inspected each shift. An additional inspection would take place during scheduled maintenance shutdowns. A ditch paralleling the entire length of the pipelines would contain and transport any discharged tailings to the tailings impoundment. Containment and surface water runoff ditches would be constructed with an earthen berm between them. This berm would ensure that in the event of a rupture, all tailings would remain in ditch and not come in contact with surface waters. Where the pipelines cross Poorman Creek, a lined flume and trestle would be constructed.

The proposed tailings impoundment area is about five miles northeast of the plant site, in the Little Cherry Creek watershed. The impoundment dam (embankment) would be constructed in stages over the 16-year operating period using coarse (sand) tailings. Noranda has evaluated expected tailings production and anticipates that adequate sand tailings would be available for dam construction. The dam would eventually be built to about 370 feet in height, with a dam crest elevation of 3,710 feet (Figure 2-11). About 100 million tons of tailings would be stored in the impoundment. The impoundment site is capable of holding 120 million tons.

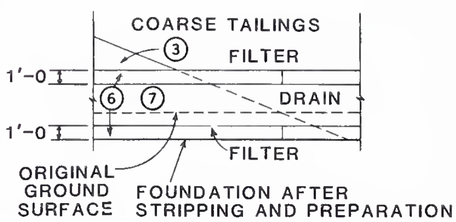
Noranda has developed general final design criteria for tailings dam stability, diversion channel design, dam and dike design, and tailings settlement in cooperation with the agencies. These criteria are described briefly in this section and in greater detail in Chapter 6–Methods. Noranda would follow stability criteria recommended by the U.S. Corps of Engineers. Noranda would also consider the effects of earthquakes in dam stability. The Maximum Credible Earthquake event *(see Glossary)* has been used in stability analyses. Noranda used estimated runoff from the 24-hour general storm Probable Maximum Precipitation event for sizing containment requirements in the tailings impoundment. Since the tailings impoundment would occur in a small watershed, the 6-hour local storm Probable Maximum Precipitation event was used for sizing diversion requirements.

The impoundment area would consist of several structures, including the tailings retention dam (which would include a starter dam and a toe dike); a diversion dam; two earth-filled saddle dams; a seepage collection dam and pond; and a diversion channel. Construction of the diversion channel for Little Cherry Creek and an 85-foot high diversion dam would be concurrent with vegetation clearing for the tailings impoundment. After the diversion dam is complete, the starter dam, seepage collection dam, and toe dike would be built. Excavated channel material would be used to construct the diversion dam and the starter dam; any remaining material from the excavation would be used to construct a portion of the south saddle dam. The remaining portion of the south saddle dam and the north saddle dam would be constructed with borrow area materials and mine waste rock. To supplement materials excavated during diversion channel construction, about 1.3 million cubic yards of material would be excavated from borrow areas. Noranda has identified four borrow areas, one within the impoundment area (Borrow Area A) and three west and south of the impoundment area (Borrow Areas B, C and D), for possible sources of embankment material. These areas are shown in Figure 2-11. If all four of these borrow areas are disturbed, the tailings impoundment and associated structures would affect about 994 acres.

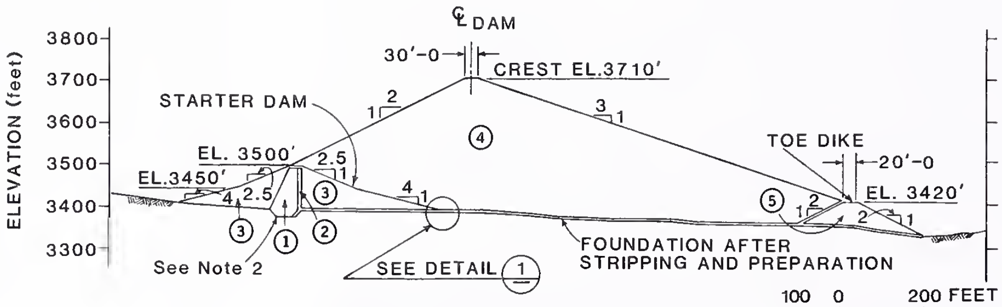
Prior to impoundment construction, the site would be cleared of vegetation and stripped of soils suitable for reclamation. The ground surface would be scarified and compacted before dam construction. Any sandy or gravelly soils exposed during excavation operations would be covered with a three-foot thick layer of compacted clayey soil to minimize water infiltration from the tailings impoundment or from the seepage collection pond. The clayey soil would be



SITE PLAN



DETAIL 1



CROSS-SECTION A

NOTE:

1. Above el. 3405' Toe Dike Crest is 15'-0 above Foundation.
2. Surface to be seeded with grass.

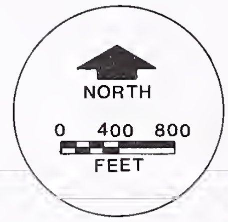
Source: Morrison-Knudsen Eng., Inc. 1990a.

LEGEND

ZONE	DESCRIPTION
1	GRAVELLY SANDY CLAY OR SANDY CLAYEY SILT
2	SILTY SANDY GRAVEL AND COBBLES
3	WEATHERED BEDROCK, MIXTURE OF COBBLES, GRAVEL, SAND CLAYEY SOIL
4	CYCLONED TAILINGS SAND
5	RUN OF MINE WASTE ROCK
6	SAND FILTER
7	GRAVEL DRAIN

FIGURE 2-11

TAILINGS IMPOUNDMENT SITE



excavated from within the impoundment area or the proposed borrow areas.

A permanent diversion system would be constructed at the impoundment site to route Little Cherry Creek around the impoundment to an unnamed tributary of Libby Creek (Figure 2-12). Little Cherry Creek below the tailings impoundment would no longer receive surface flows from above the diversion. The diversion pond and diversion channel would be about 4,600 feet long from the pond inlet to the channel outlet. The diversion channel would be about 3,400 feet long with a bottom width of 20 feet. The channel sides would be protected from erosion by a two-foot layer of rock riprap. The hydraulic capacity of the diversion channel is designed for the 6-hour Probable Maximum Flood requirements, while the two-foot riprap thickness is designed for the 100-year flood flow.

Within the diversion channel, a secondary channel would be constructed. The channel would be designed to contain the average annual high flow in the active channel. The channel foundation would be lined with compacted silty clay/clay in an attempt to perch surface flows above the riprap. Steep sections of the channel would consist of a series of stepped drop structures that would provide energy dissipation in the event of high flows. Noranda anticipates the channel might allow fish migration, depending on flow conditions.

Initial erosion protection for the stream channel downstream of the diversion channel is not planned because Noranda believes the heavily timbered natural channel would provide sufficient erosion protection. The diversion channel design includes a 300-foot, stair-stepped chute structure at the channel outlet. This structure, which would be comprised of three-foot high gabions, is designed to dissipate flow energy, minimize erosion potential, and increase channel stability. If erosion is observed during or at the end of operations, rockfill bars or gabions would be placed perpendicular to the natural stream channel below the diversion channel to provide energy dissipation and protect against erosion. Runoff from the impoundment area would be minimized by building permanent diversion ditches around the impoundment site to intercept and divert water. Temporary diversion ditches would be built to control runoff within the impoundment site.

During operations, horizontal seepage through the dam and surface water runoff would be intercepted with a downstream collection and containment system. Noranda estimates embankment seepage would increase over the life of the project, reaching 673 gpm during Year 16, the last year of operation. Seepage water passing through the tailings dam would be collected by ditches and routed to a seepage collection pond. Water from the seepage collection pond would be pumped back to the tailings impoundment.

A rockfill toe dike would be constructed upstream of the seepage collection ditches during the impoundment's operational life. The toe dike would intercept any tailings eroding from the downstream dam face. Sand and gravel filters would be placed on the toe dike upstream face to prevent tailings from passing through the dike.

During final design, Noranda would use conventional methods to estimate the amount of tailings settlement. Noranda would use the estimate to design the final reclaimed pond surface configuration and to determine the amount of earthwork that would be required.

Pressure Relief/Seepage Control & Interception System

As the dam is raised, impoundment seepage would be controlled through a blanket drain and trunk drains. The blanket drain would extend from the centerline of the starter dam beneath the toe dike (Figure 2-11). The blanket drain would consist of gravel layers two-feet thick in the valley bottom decreasing in thickness to one foot at higher elevations. One-foot thick sand filter blankets would be located both above and below the blanket drain to prevent piping of the tailings and foundation soils

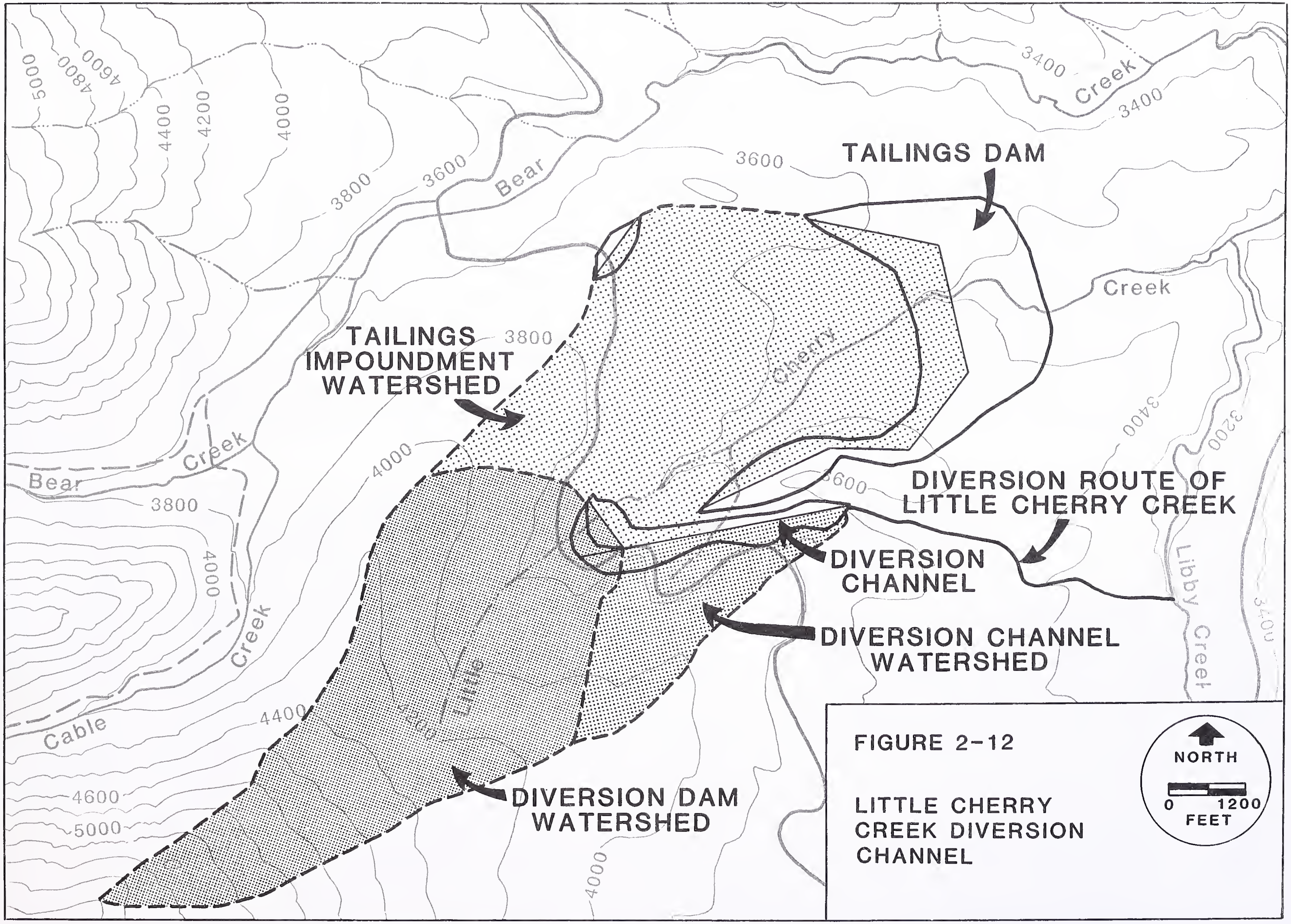


FIGURE 2-12

LITTLE CHERRY CREEK DIVERSION CHANNEL

into the gravel blanket drain (Figure 2-11). The trunk drains would be situated within the two main drainages that cross the dam foundation, and would extend from the downstream toe of the starter dam to the upstream toe of the toe dike. Each trunk drain would consist of a four-foot thick layer of gravel that would be covered and underlain by one-foot thick sand filters. The drain and filter materials would be purchased from commercial sources near Libby or else processed from on-site quarried rock or mine waste rock.

Artesian ground water conditions occur at the proposed impoundment site. Noranda has proposed a pressure relief system to relieve the upward pressure caused by these conditions. The system also would collect seepage that has entered the ground water underlying the impoundment. The system would consist of closely-spaced wells along the toe of the starter and tailings dam. Noranda's initial design is a passive well system. Some of the wells would be equipped with pumps, if necessary, to increase seepage interception or reduce pressure. The number of wells necessary would be determined during the first several years of operation, when impoundment seepage is limited (Table 2-5 in *Water Use and Management* section]. The initial set of relief wells would be placed at the toe of the starter dam about 200 feet apart, depending on site conditions. Monitoring wells would be installed midway between some of the relief wells (Figure 2-11). Relief wells would be constructed at varying depths (from shallow near-surface wells to deeper bedrock wells) both to provide pressure relief and to collect seepage from the tailings impoundment. Well construction details would depend on site conditions, such as depth to bedrock, depth to ground water, and depth to artesian conditions, if present at well location. Increased pressures in the material underlying the impoundment would be measured in the monitoring wells. This information would be supplemented by surveying surface markers on the foundation and visually observing foundation conditions.

The initial set of monitoring and relief wells placed at the toe of the starter dam would eventually be covered as the tailings dam is constructed over the starter dam. Before being covered, the monitoring wells would be opened to the drainage blanket of the main dam (Figure 2-11) and incorporated into the drainage system as auxiliary relief wells. Coarse gravel would be placed in the wells before covering them. New wells would be installed before covering existing wells. Noranda's conceptual design for well spacing at final dam construction is shown in Figure 2-11. More than 100 wells may be installed by Year 16 of operations. Because covered wells would likely provide some pressure relief, well spacing would likely increase for wells installed subsequent to the starter dam.

Besides collecting tailings water seepage, the pressure relief/seepage interception system would intercept ground water. Noranda estimates that the percentage of seepage intercepted by the system would gradually increase as the seepage increases. Noranda predicts that 70 percent of the relief well interception in Year 1 of operations would be tailings impoundment seepage. Noranda estimates that by Year 16, 97 percent of the relief well interception would be tailings impoundment seepage (see the following *Water Use and Management* section). The intercepted water (seepage and existing ground water) would be pumped back into the tailings impoundment, reaching an estimated 390 gpm in Year 16. The actual amount pumped back to the tailings impoundment would vary depending on artesian pressures encountered, amount of seepage, and tailings water quality.

Following operations, the pressure relief/seepage collection system would remain in place and water would continue to be pumped back to the impoundment. The tailings impoundment would be partitioned to provide an area for water storage. The remainder of the tailings impoundment surface and the embankment would be regraded, topsoiled and revegetated (see *Reclamation* section). Water intercepted and recycled to the impoundment would be

evaporated using sprinklers, described in the following *Water Use and Management* section. The post-operational water balance would include additional water disposal to the land application disposal area, and to constructed wetlands near the impoundment to the extent allowable by water quality considerations (see *Wetlands Mitigation Plan*). As embankment seepage and required seepage collection decrease, the storage requirement on the tailings impoundment would decrease and additional area would be reclaimed. When reclamation of the tailings surface is complete and as seepage from beneath the impoundment decreases, the amount of water pumped back would decrease. Depending on tailings water and ground water quality, pumping would eventually cease. Inflow into the reclaimed tailings pond would be limited to infiltration. Outflow from the reclaimed tailings pond would consist of seepage from beneath the impoundment and through the dam. The phreatic surface (water level) in the impoundment would reach equilibrium when the inflow equals the outflow. Noranda estimates that equilibrium conditions would be reached in 20 to 25 years if the seepage collection dam is removed, or 35 to 40 years if the dam is left in place and dam seepage is returned to the impoundment.

Water Use and Management

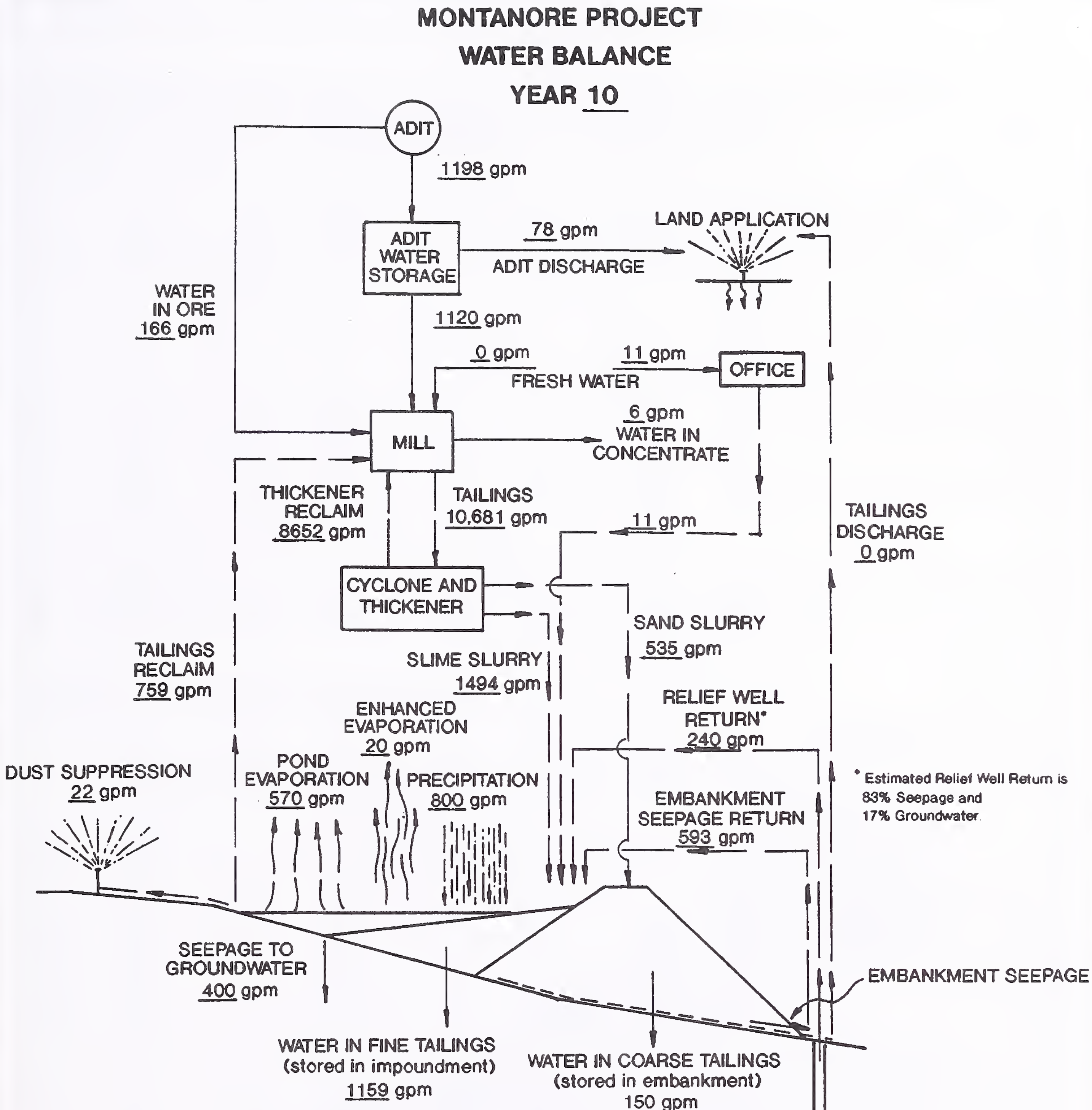
Makeup water requirements. The mill would require 10,687 gpm of water during full production (Figure 2-13; Table 2-5). Most of this water would be either reclaimed from the tailings thickener or pumped from the tailings impoundment. Water reclaimed from the tailings impoundment would be pumped in pipes which parallel the tailings pipelines. In the operational water balance, Noranda estimates tailings would be slurried to the impoundment at a tailings solid content of 62 percent by weight, using 2,029 gpm of water for slurry. This density is higher than that typically achieved (Vick, 1983). Should additional water be required, the amount of water pumped from the tailings impoundment would be increased without affecting the overall water balance.

Some water would be available from mine and adit inflows; Noranda estimates that 1,198 gpm would be available from inflows during the last year of operations. Less inflow water would be available in earlier years. A portion of this water would be diverted to underground collection sumps for settling and storage for later use. Up to Year 10, the remaining water would be pumped to the surface for use in the milling process. After Year 10, a portion of the water would be discharged to the land application disposal areas.

During the initial years of mill operation, additional water would be required to supplement inflow water and reclaimed water as well as to provide potable water. Noranda has identified several potential sources of additional water. During Year 1 of operations, Noranda would store an estimated 131 gpm of excess water in the tailings impoundment; Table 2-5 shows 131 gpm more tailings pond inflow than outflow. In Year 2, the stored water would be used as mill makeup water and outflows (2,512 gpm) from the impoundment would exceed inflows (2,381 gpm) by 131 gpm (Table 2-5).

During Libby Creek adit construction, Noranda grouted extensively to reduce adit inflows, particularly where the adit is close to the ground surface. Measured flow from the Libby Creek adit is displayed in Figure 2-14. A similar program would be used to control inflows in the Ramsey Creek adits. During operations, drilling through the grout could increase adit inflows. Noranda is currently conducting hydrologic tests in areas previously grouted in the Libby Creek adit to determine the feasibility of using adit water as additional makeup water, if necessary.

Temporary diversion ditches within the impoundment working area would be used to control water from undisturbed areas. If additional water is required, precipitation and snowmelt from undisturbed areas within the impoundment working area could be directed to the impoundment and could be pumped back to the mill to meet makeup water requirements.



Source: Noranda Minerals Corp. 1991.

FIGURE 2-13

PROJECT
WATER BALANCE

Table 2-5. Average process water balance—Years 1, 2, 3, 4, 5, 10, 16 and 18 of operations.

Source	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10	Year 16	Year 18
	gallons per minute							
Mine and adit discharge								
Total discharge	588	631	674	717	760	1,188	1,198	0
Discharge to land application areas	0	0	0	0	0	78	183	0
Net discharge to mill	588	631	674	717	760	1,110	1,015	0
Office inflow								
Potable water	11	11	11	11	11	11	11	0
Office outflow								
Discharge to tailings impoundment	11	11	11	11	11	11	11	0
Mill inflow								
Net discharge from adit	588	631	674	717	760	1,110	1,015	0
Additional water makeup	0	20	385	377	370	0	0	0
Water in ore	90	131	166	166	166	166	166	0
From thickener	4,672	6,835	8,652	8,652	8,652	8,652	8,652	0
From tailings impoundment	421	826	810	775	739	759	854	0
Subtotal	5,771	8,443	10,687	10,687	10,687	10,687	10,687	0
Mill outflow								
Tailings to thickener	5,768	8,438	10,681	10,681	10,681	10,681	10,681	0
Water in concentrate	3	5	6	6	6	6	6	0
Subtotal	5,771	8,443	10,687	10,687	10,687	10,687	10,687	0
Thickener inflow								
Tailings from mill	5,768	8,438	10,681	10,681	10,681	10,681	10,681	0
Thickener outflow								
Coarse tailings to impoundment	289	423	535	535	535	535	535	0
Fine tailings to impoundment	807	1,180	1,494	1,494	1,494	1,494	1,494	0
To mill	4,672	6,835	8,652	8,652	8,652	8,652	8,652	0
Subtotal	5,768	8,438	10,681	10,681	10,681	10,681	10,681	0
Tailings pond inflow								
Storage	0	131	0	0	0	0	0	134
Precipitation	260	343	425	508	590	800	1,020	680
Coarse tailings from thickener	289	423	535	535	535	535	535	0
Fine tailings from thickener	807	1,180	1,494	1,494	1,494	1,494	1,494	0
Embankment seepage return	222	344	449	477	501	593	673	268
Seepage interception return	60	80	100	120	140	240	390	332
Sanitary wastes	11	11	11	11	11	11	11	0
Subtotal	1,649	2,381	3,014	3,145	3,271	3,673	4,123	1,414
Tailings pond outflow								
Discharge to land application areas	0	0	0	0	0	0	0	207
Dust suppression	4	6	8	10	12	22	42	42
Enhanced evaporation	0	0	0	0	0	20	40	40
Natural evaporation	115	191	268	344	420	570	730	365
Water in coarse tailings	81	119	150	150	150	150	150	0
Water in fine tailings	625	916	1,159	1,159	1,159	1,159	1,159	0
Seepage into ground water	50	110	170	230	290	400	475	395
Seepage through embankment	222	344	449	477	501	593	673	268
To mill	421	826	810	775	739	759	854	0
Subtotal	1,518	2,512	3,014	3,145	3,271	3,673	4,123	1,317
Net Discharge to Groundwater								
Discharge to land application disposal areas + seepage to groundwater - percentage of relief well return	8	53	97	140	182	272	280	280

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-130; revised May, 1992.

Using pumps at the pressure relief/seepage interception system, as described in the preceding section, could increase available water. Fresh water wells could be constructed in the land application disposal area or the tailings impoundment area. No exploratory drilling has been conducted to identify a specific ground water supply source.

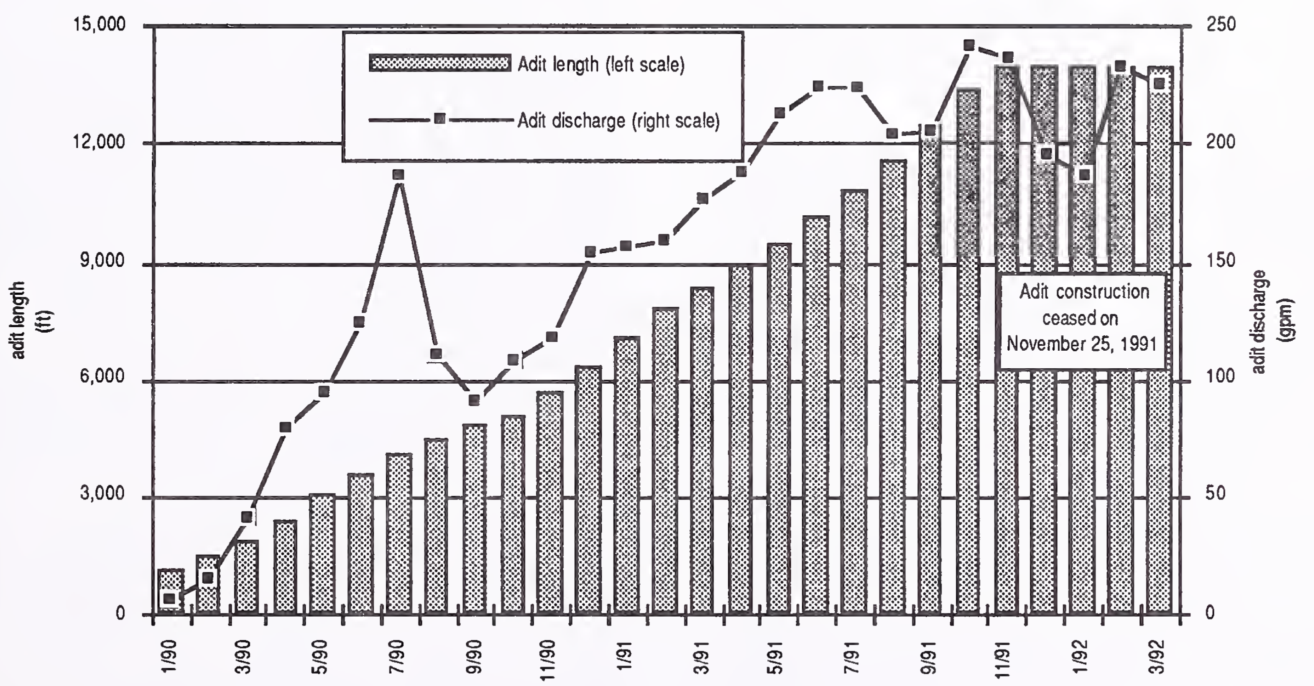
As a last resort, surface water from either Ramsey Creek or Libby Creek would be used. Surface water diversion would only be required if other sources could not adequately supply the necessary water. Noranda would acquire all necessary water rights and permits before any such diversion.

Excess water management. Noranda has developed contingency plans for handling excess mine inflow and excess tailings water. If sustained mine or adit inflows exceed 1,200 gpm or should excess tailings water occur, Noranda would notify the agencies, evaluate alternatives to handle the excess water, and initiate appropriate action.

Possible water control alternatives include grouting fractures and joints to reduce ground water inflows, discharging segregated clean adit water to surface or ground water, providing temporary storage in the tailings impoundment coupled with enhanced evaporation (evaporating water by spray irrigation, either at the tailings impoundment or the land application disposal areas), and diverting water around the tailings impoundment using temporary diversion ditches. These techniques are briefly discussed in the following sections. Chapter 4 provides the agencies' evaluation of these techniques.

Grouting. The bedrock which would be encountered by the adits and mine has a very low permeability. Several large faults and smaller fractures, capable of

Figure 2-14. Libby Creek adit water discharge†



Source: Noranda Minerals Corp. March 9, 1992—on file with the agencies.
†Average discharge shown includes up to 34 gpm of fresh water used in drilling and blasting operations.

storing and transmitting ground water, would be encountered during mine development. To reduce the amount of water entering the adits and mining areas, Noranda would grout areas where water is flowing into the adits and mine workings. Grouting would be used as the primary mechanism to reduce adit and mine inflows.

Land application. Noranda would dispose of adit and mine inflows during operations at two land application disposal areas along Ramsey Creek (Figure 2-7). Noranda is currently discharging Libby Creek adit water at a percolation pond/land application disposal area near the adit portal (Figure 2-5). The Libby Creek area would be used during operations only as a backup disposal site to discharge adit water with quality equal to or better than ambient water quality at the area.

Concurrent with the Libby Creek adit completion, Noranda would construct a small (10 acres) percolation/surge pond at land application disposal (LAD) area no. 1 (Figure 2-7). Vegetation would be removed from the disturbed area prior to topsoil salvage. Noranda estimates about 58 acres of disturbance (ponds, embankments, access roads and ditches) would occur at site no. 1. Noranda estimates land application disposal area #2 may require an additional 20 acres or more of disturbance. A drip/spray irrigation system would be installed over an area of about 221 acres. Irrigation pipes would be laid underground in shallow ditches/trenches. Spray irrigation during growing season also may be used. The irrigation area would require only selective tree thinning, access road construction and little topsoil salvage.

The land application disposal areas would be increased gradually to reflect the increasing quantity of water encountered during adit construction. The final size of the land application disposal area would be dependent on the quantity of water entering the mine (mine inflow), precipitation, and evaporation. The disposal system would be designed to discharge up to 2,000 gpm of excess water. The entire land application permit areas (472 acres) would not be disturbed unless mine inflows are considerably greater than Noranda estimated.

Noranda anticipates completing the Libby Creek adit in the first three months of the project. During this period, nitrogen concentrations in adit water are expected to be elevated due to blasting. All adit water from the Libby Creek adit (estimated maximum of 280 gpm) would be discharged to the Ramsey Creek (LAD) area. A pipeline would be constructed to pipe Libby Creek adit water to the Ramsey Creek LAD area. The pipeline would parallel Road #6210.

After completion of the Libby Creek adit, work would begin to evaluate the orebody through exploratory drilling and construction of raises and laterals. During this period, inflows to the Libby Creek adit (post-construction adit water) would contain low nitrogen concentrations. Inflows from the active exploration development (mine water) would be affected by blasting and would contain elevated nitrate levels. Both post-construction adit water (280 gpm) and mine water (11 gpm) would be discharged to the Ramsey Creek LAD sites.

Noranda anticipates construction of Ramsey Creek adit to tie in with Libby Creek adit would begin about 6 months after project inception and take about 12 months. Noranda would construct the Ramsey Creek adit from both the surface at the Ramsey Creek portal, and underground with access from the Libby Creek adit decline. Inflows to the Libby Creek adit (post-construction adit water), inflows to the Ramsey Creek adit (construction adit water), and inflows to evaluation workings (mine water) would be discharged via the Libby Creek adit to the Ramsey Creek LAD sites.

After the Ramsey Creek adit reaches the orebody, all Ramsey Creek adit inflows (262 gpm) and mine inflows (11 gpm) would be discharged to the Ramsey Creek LAD sites via the Ramsey Creek adit. Inflows to Libby Creek adit (280 gpm) would continue to be discharged to the Ramsey Creek LAD sites as long as nitrogen levels remained higher than

ambient surface water concentrations. If post-construction adit water from the Libby Creek adit is equal or better than ambient surface water quality in Libby Creek, post-construction adit water could be discharged to Libby Creek adit percolation pond/land application disposal area near upper Libby Creek.

Noranda also plans to use the Ramsey Creek land application disposal area for water disposal, estimated to begin in Year 10 of operations. The water quality assessment discussed in Chapter 4 assumes all operational excess water discharges would occur at the Ramsey Creek site and no discharges would occur at the Libby Creek site. Adit water would be segregated from mine water and disposed at the land application disposal area along Ramsey Creek. Noranda estimates that 183 gpm of adit water would be disposed in Year 16 of operations (Table 2-5).

Noranda's projected water balance is an estimate of inflows and outflows to various project components. Noranda would maintain a detailed water balance which would be used to monitor water use. Actual volumes for a number of balance variables, (e.g., mine and adit inflows, precipitation and evaporation, dust suppression) would vary seasonally and annually from the volumes shown in the balance. Additionally, the amount of water Noranda would intercept with the pressure relief/seepage interception system would depend on estimated seepage, tailings water quality and resulting ground water quality.

Noranda has indicated in the supplemental petition information that additional land application disposal areas are available (Noranda Minerals Corp., 1992a). Areas around the impoundment, such as the proposed borrow areas, could provide additional space for land application. Noranda indicated these areas could be used if unacceptable water quality occurs in the Ramsey Creek LAD area.

Water segregation. Regardless of the amount of grouting, some water inflows would occur. Noranda would use up to 1,110 gpm of inflow water in ore processing. If additional water is encountered, Noranda would segregate "clean" inflow water, primarily adit inflows, from water affected by mining. An array of holes would be drilled into a water-producing zone and the water would be directed to a collector pipe. If water quality meets applicable standards, Noranda could discharge this water to Ramsey Creek or Libby Creek. Prior to discharge to surface water, Noranda would need to obtain a Montana Pollutant Discharge Elimination System permit. Excess water not discharged to surface waters would be discharged at the LAD area or stored in the tailings impoundment.

Tailings impoundment storage. The tailings impoundment also would serve as a water storage structure. Based on the proposed dam construction schedule and expected tailings volumes, Noranda estimates three years of storage capacity would be available for expected mine and adit inflows. During the first year of operations, Noranda would store an estimated 131 gpm of water in the impoundment. The stored water would be used the following year. During other years, the seasonal and annual fluctuations in water availability and water requirements would be managed using the storage capacity of the impoundment.

Dust suppression/enhanced evaporation. Noranda has proposed a spray irrigation system (enhanced evaporation system) to dispose of the intercepted ground water and tailings impoundment seepage. Tailings water would be used to control dust at the tailings impoundment site throughout the project. Starting in Year 10 of operation, additional water would be evaporated at the land application disposal areas. The spray irrigation system would be adjusted to achieve different evaporation rates. In Year 16 of operations, an estimated 82 gpm of excess water would be evaporated using such a system. Noranda has assumed no additional discharge to ground water would result from the spray irrigation (Table 2-5).

Temporary diversion. In the event of a surplus water balance, Noranda would divert water collected by the temporary diversion ditches within the impoundment

area, but above the expanding tailings pond. These ditches would divert surface runoff from undisturbed lands within the tailings impoundment perimeter into the Little Cherry Creek diversion, thereby reducing the amount of water entering the tailings impoundment.

Petition for Change in Water Quality

Based on the agencies' analysis, surface and ground water quality would be affected by Noranda's proposed discharges to the land application disposal areas, and by seepage from the tailings impoundment (see *Surface Water Hydrology* and *Ground Water Hydrology* sections of Chapter 4). Pursuant to the non-degradation rules of the Montana Department of Health and Environmental Sciences (ARM 16.20.701 and ARM 16.20.1001), Noranda has submitted a petition to the Board of Health and Environmental Sciences to change the quality of ambient waters (Noranda Minerals Corp., 1989h). Noranda submitted supplemental petition information to the agencies in May 1992 (Noranda Minerals Corp., 1992a). The concentrations to which Noranda has requested a change are shown in Table 2-6.

Changes in ground or surface water quality above ambient concentrations is prohibited unless the Board of Health and Environmental Sciences determines that the changes are justified as a result of necessary social or economic development, and that the changes would not preclude present or anticipated uses of the water resources. The Board of Health and Environmental Sciences, however, cannot approve water quality changes beyond the water quality standards established by regulation (Montana Department of Health and Environmental Sciences, 1990, letter to individuals who submitted written comments on Noranda's petition; on file at DHES).

Surface Water Control

Surface water from the plant site would be directed to a collection ditch on the south side of the plant site. The water would then flow by gravity to a sediment pond sized to accommodate a 24-hour, 100-year

Table 2-6. Surface and ground water quality limits requested by Noranda.

	Surface water				Ground water	
	Ambient water quality			Requested	(Ambient)	Requested
	RA 600	PM 1000	LB 2000	limit	WDS-1	limit
Parameter	(mg/L)					
Total dissolved solids	<10.5	25	33	100	50	200
Ammonia	<0.1	<0.05	<0.05	1.5	—	*
Nitrate/nitrite	0.07	0.04	0.03	5.5	0.16	10
Arsenic	<0.005	<0.005	<0.005	<*	0.005	*
Cadmium	<0.0001	<0.0001	<0.0001	<*	0.001	*
Chromium (total)	<0.02	<0.02	<0.02	<0.005	0.02	0.02
Copper	<0.002	0.001	0.001	<0.003	0.02	0.1
Iron	<0.05	<0.05	<0.05	<0.1	0.05	0.2
Lead	<0.001	<0.001	<0.001	<*	0.01	*
Manganese	<0.02	<0.02	<0.02	<0.05	0.02	0.05
Mercury	<0.0002	<0.0002	<0.0002	<*	0.0002	*
Silver	<0.0002	<0.0003	0.0003	<*	0.001	*
Zinc	<0.02	<0.02	<0.02	0.025	0.06	0.1

Source: Noranda Minerals Corp. May 22, 1992
* = No change in ambient water quality requested

storm event, four hours retention of the thickener overflow, and freeboard (distance from surface of a pond to top of a dam). The pond also would receive overflow from the thickener. Excess water in the pond would be used in the mill.

An interceptor ditch would be constructed on the plant's north side to divert surface runoff from undisturbed areas upstream of the plant site. The flow would then pass through culverts at the main access road and discharge into Ramsey Creek.

Noranda would be responsible for snow removal from all access roads and the plant site. Snow removal would follow Forest Service guidelines. Snow and ice removed from the plant site would be disposed at the land application disposal areas. All debris removed from the road surfaces except snow and ice would be deposited away from the stream channels. Culverts would be kept free of snow, ice and debris.

Waste Management

Solid Waste. During the initial development phase, portable facilities, such as Porta-Potties, may be used to handle sanitary wastes. As an alternative, a septic tank and drainfield may be used. During the operating phase, sanitary wastes would be treated by a sewage treatment facility near the plant. Detailed designs for handling sanitary wastes would be submitted for review and approval by appropriate health authorities. Effluent from the treatment plant would be disposed in the tailings impoundment, and sludge would be disposed at an approved, off-site facility.

Most solid wastes would be transported off-site to an approved county landfill. No hazardous wastes would be generated by the operation. Inert wastes, such as wood and concrete, would occasionally be buried on-site in selected areas, in accordance with applicable state regulations and with KNF approval.

Accidents and spills. Noranda would use reagents in the milling process, propane and fuel oil for equipment and heating, and small quantities of other various chemicals. Concentrate would be shipped offsite via 20-ton trucks. The access road crosses three creeks and follows Ramsey Creek to the plant site. Noranda has developed a Spill Prevention and Preparedness Plan for the project (Noranda Minerals Corp., 1989b). Noranda would notify local authorities immediately of any accident or spill. A formal written report to the agencies would be prepared within 30 days of any incident. Clean-up measures and monitoring would depend on the type and magnitude of the spill, and whether the spill material could affect surface or ground water quality.

Transportation

Access to the proposed plant site would be via USFS Road 278 (Bear Creek Road) and Road 4781. Approximately 11 miles of the Bear Creek Road, from U.S. 2 to the Bear Creek bridge, would be paved and upgraded to applicable USFS standards. The road would be 20- to 29-feet wide, paved (chip-and-seal), and designed to handle speeds of 35 to 45 mph. Bridges on the road would be widened and upgraded to handle standard highway loads. Cuts and fills associated with new access roads and upgrading of the Bear Creek Road would total 22 acres. While Bear Creek Road is upgraded (one to two years), USFS Road 231 (Libby Creek Road) would be used for access.

From the Bear Creek bridge to the Ramsey Creek plant site, 7.5 miles of road would be relocated and reconstructed. This section of road would also be a chip-and-seal surfaced road and 20- to 29-feet wide. Five miles of this road would follow the tailings lines from the plant site to the tailings impoundment site. Four thousand feet of new, single lane road would be constructed as access for portions of the tailings lines.

Noranda would build a bridge across Ramsey Creek to provide access from the plant site to the Ramsey Creek portal patio. A temporary crossing would be used prior to bridge construction.

Noranda proposes to use USFS Road #6210 (between Ramsey Creek and Libby Creek) as an access road to the Libby Creek adit. Noranda would use the road during the construction period to haul waste rock. A temporary bridge would be constructed across Ramsey Creek to provide access to the road from the Ramsey Creek road. Noranda would close the road and remove the bridge after all waste rock has been removed. Noranda would use segments of the Libby Creek Road (#2316), the Fisher-Libby Creek Road (#231), and the Bear Creek Road (#278) during operations for occasional access to the Libby Creek adit (Figure 2-3). Noranda anticipates these road segments would not require reconstruction before use. It would discuss with the KNF any necessary modifications. The Libby Creek Road (#2316) is one of the roads Noranda proposes that the KNF would close following construction (*see Grizzly Bear Mitigation Plan* section).

Access road maintenance would be Noranda's responsibility, unless additional use by the KNF or other interests would warrant a cost-share agreement. This responsibility would revert to the KNF following project completion. Traffic to the mine would use U.S. 2 and would include employee commuting and weekday delivery of supplies (Table 2-7).

Public access to the areas surrounding operations would be restricted until mining and reclamation activities are completed. Undisturbed areas not fenced would not be restricted. Existing access to Poorman Creek and Cable Creek drainages would not change. Access to upper Ramsey Creek would be restricted by a gate at the plant site boundary. Existing access on the Libby Creek Road would remain; access to the Libby Creek adit and disturbed areas would be restricted by gates and fences. Livestock grazing would be excluded from areas the project may disturb until vegetation is reestablished.

Project Employment

The preproduction phase would entail—

- access road construction;
- mine development and mill construction;
- transmission line construction;
- plant access road alterations;
- tailings dam and related facilities construction; and
- installation of service facilities.

It is estimated 30 employees would begin work the first quarter of Year 1 and employment would peak during Year 2 with 530 employees over a 30-month period. All surface construction and the majority of underground mine development during the preproduction phase would be completed by contractors. Noranda anticipates contractors would work a seven-day work week with three shifts a day.

Following completion of the construction period (at the end of the third year), total employment is

Table 2-7. Estimated daily vehicle count.

Vehicle	Daily trips	Vehicle types	Time
Concentrate trucks	21	20-ton capacity	Day shift
Supply trucks	5	Various	Day shift
Pickups	30	0.5 to 1 ton capacity	10 per shift
Employee vehicles	300	Cars and 0.5 to 7.5 ton trucks	Day shift 134 Swing shift 83 Night shift 83

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-115.

estimated to be 450 workers, with an annual payroll of $12 million. This level of employment is expected to remain constant throughout the mine life.

Following completion of all surface construction, and mine and mill development, full production would be achieved over a 12-month period. Permanent project facilities would operate 24 hours a day, 7 days a week, for 350 days a year.

To insure a maximum participation by local job seekers Noranda would conform to the following hiring policies—

- Employment opportunities would be initially advertised locally in Lincoln County;
- Noranda would utilize the services of the local Job Service office for positions that can be filled by local job seekers; and
- Noranda would institute training programs for most positions and work with the local job service and community to provide maximum opportunity to local applicants.

Power Supply and Other Utilities

The plant site's electrical service would be 230-kV, 3-phase, 60-cycle, provided via a new, overhead transmission line (see Figure 2-15). Two substations would be required. One substation would be used to tap the Noxon-Libby 230-kV line and supply power to the mine site over a new 230-kV transmission line. At the Ramsey Creek plant site, a second substation would be constructed to distribute electricity through lower voltage lines to equipment in various locations at the plant site, the Libby Creek adit, the tailings impoundment site, and within the underground mine.

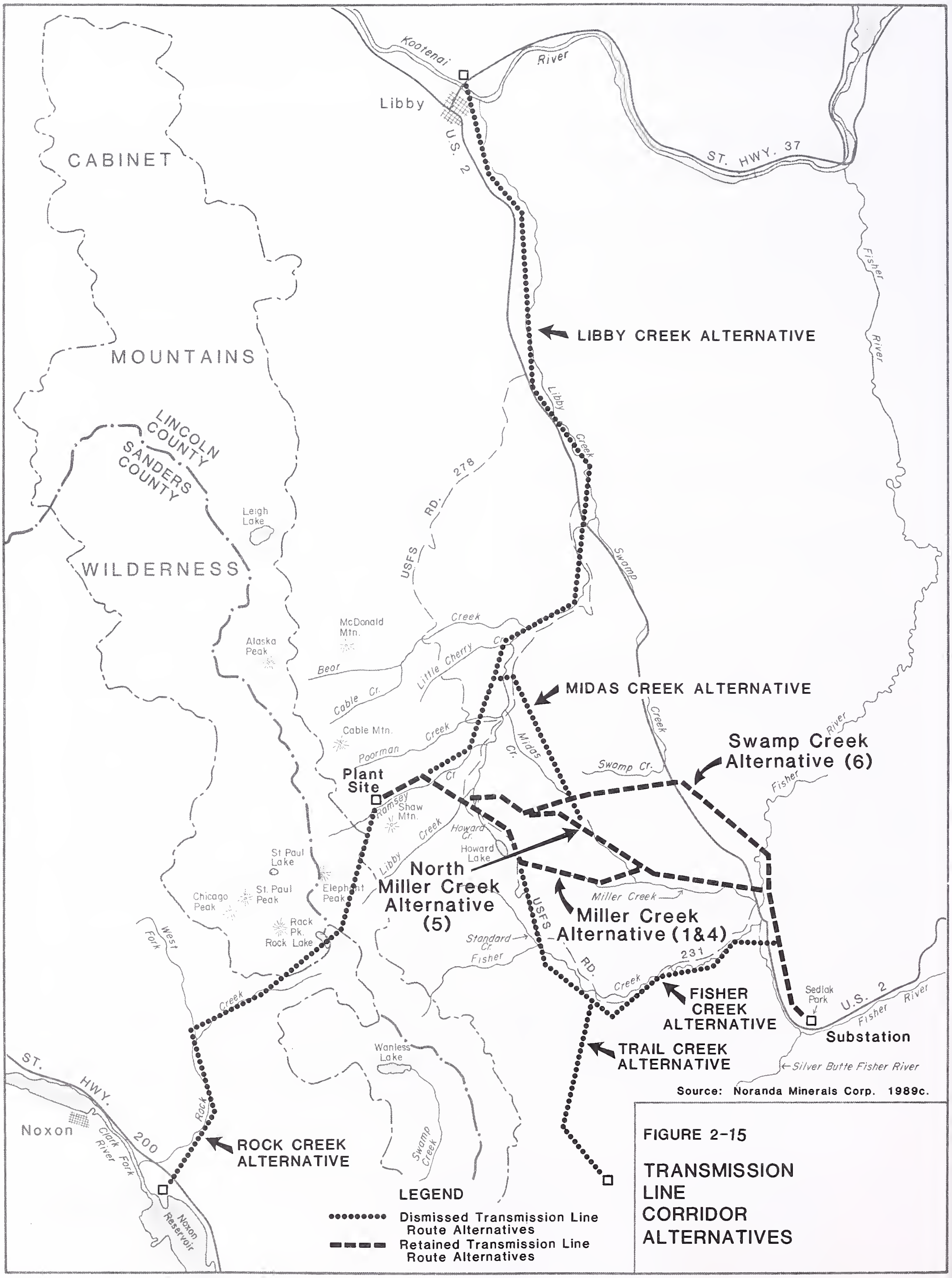
Annual energy consumption is estimated at 280 million kilowatt hours, with a peak demand of 40,500 kilowatts. Telephone service would be supplied by a buried cable line along the Bear Creek access road. Construction and routing of the proposed transmission line is described further in the following sections.

Substation equipment and location. Transmission line corridor alternatives would use monopole steel construction for the transmission line from a new substation on BPA's Noxon-Libby 230-kV line near Pleasant Valley, Montana (Figure 2-15). The proposed site is in an area known locally as Sedlak Park, about 30 miles southeast of Libby. The BPA would design the substation, communication system, and electrical system protection requirements. The BPA has contributed to the environmental analysis by assessing impacts from the placement of a substation and related equipment at Sedlak Park.

BPA is prohibited by law from providing power directly to a user, so it would provide power to a power supplier selected by Noranda. Noranda would be responsible for funding construction of the powerline and portions of the substation. Noranda would have to select a power supplier before BPA would issue a Record of Decision for its part of the project.

Preliminary engineering data indicate that Sedlak Park substation construction would require disturbing about 2.5 acres. Cut-and-fill amounting to approximately 16,000 to 17,000 cubic yards would be necessary to provide space for a fenced substation about 300 feet by 150 feet, and a parking area 100 feet by 100 feet. New roads 500- to 1,000-feet long would be constructed for access to the substation site, connection with BPA's Libby-Noxon line, and portions of the new line near the substation site. Approximately 200 feet of Sedlak Creek would be routed around the substation. More detailed substation design would be submitted to the agencies following on-site testing.

The substation site would be fenced. No water would be required at the site, and toilet facilities would be self-contained. No piece of equipment would contain more than 50 gallons of insulating oil, and the total amount would be less than 1,320 gallons. The insulating oil would not contain PCBs. The size of the substation and amount of insulating oil used would not require an oil spill containment



Source: Noranda Minerals Corp. 1989c.

FIGURE 2-15

TRANSMISSION LINE CORRIDOR ALTERNATIVES

system, although substation design would minimize the potential for spills. Any spills would be cleaned up in accordance with applicable regulations.

Substation operation would require construction of microwave communication equipment. The installed equipment would include a tower at the substation and a microwave repeater station on Barren Peak about three miles west of the substation. The repeater station on Barren Peak would be constructed with a helicopter, limiting disturbance to an area immediately around the site. Structures at the site would be painted or treated to attain a color to blend with the viewed landscape.

The actual location of the microwave repeater would require a line-of-sight view of the substation. Several locations near Barren Peak would offer such a view, and final location would require detail survey and design work. The 40-foot tall repeater station would occupy an area 100 feet by 100 feet and would be constructed using helicopters to minimize disturbance. A 150-foot tower would be required at the Sedlak Park substation.

The Sedlak Park substation would be designed to serve the mine and provide for possible future expansion to accommodate local needs in the Pleasant Valley to Libby area. No additional lines have been formally proposed to enter or leave the Sedlak Park substation, and such additions would require additional environmental analysis and approval under applicable state and federal laws.

Proposed transmission line route. Noranda's proposed transmission line route would follow the Fisher River and U.S. 2 north from the substation site for 4 miles. The route then would turn west and generally follow the Miller Creek drainage to its headwaters where it would cross into the Libby Creek drainage (Figure 2-15). About 0.25 miles south of Howard Lake, the line would turn northwest, passing east of Howard Lake, crossing Howard and Libby creeks at the Libby Creek Recreational Gold Panning Area. The route would continue northwestward from Libby Creek, crossing Ramsey Creek, and then would generally follow Ramsey Creek to the plant site. An additional substation would be constructed at the plant site (see Figure 2-9) to distribute electricity to equipment at the mine site, tailings impoundment, and the Libby Creek adit.

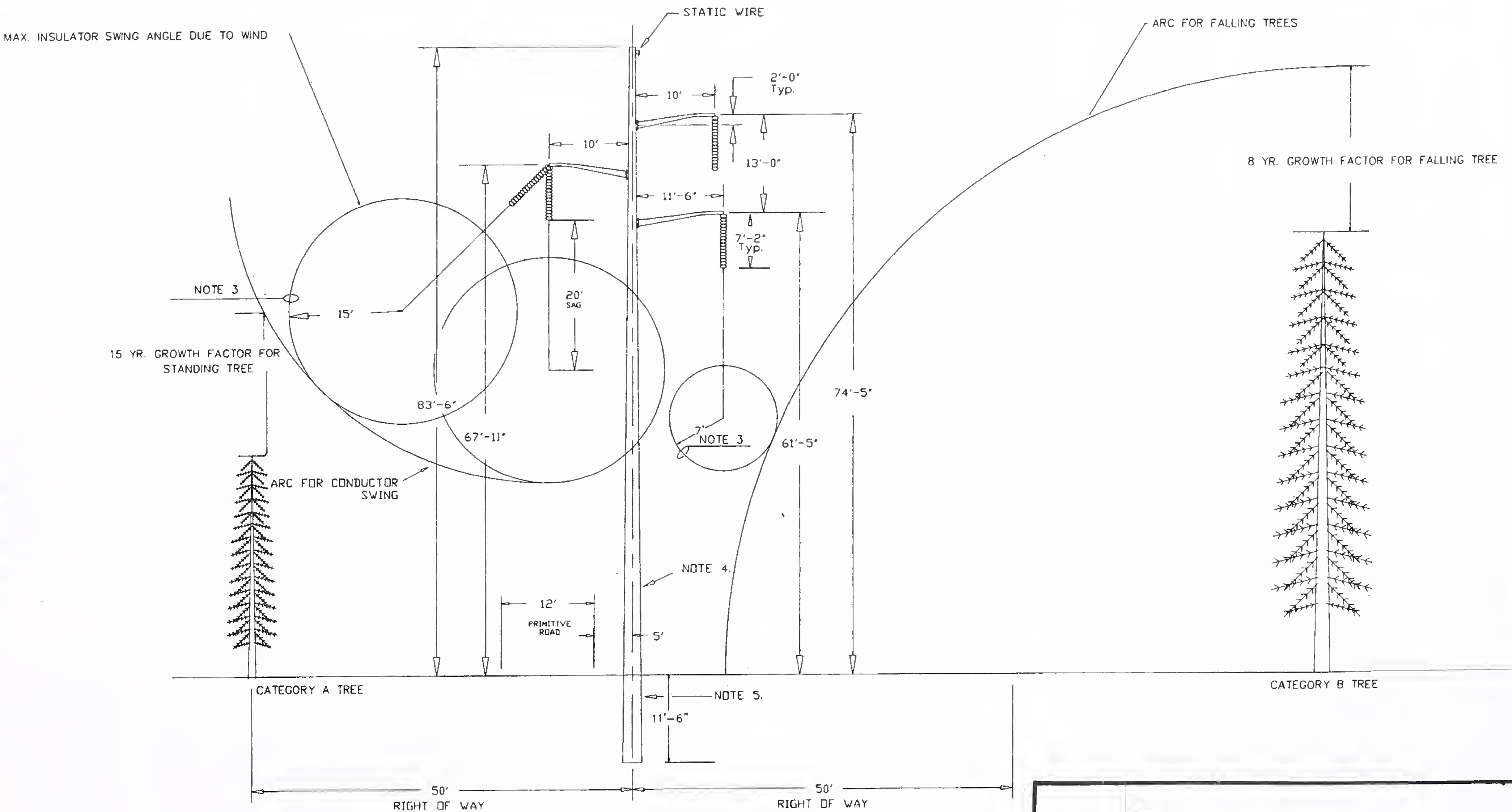
Line construction methods. Steel monopole structures would be used to reduce tree clearing and visual impacts along the 100-foot right-of-way (Figure 2-16). The steel poles would be built to provide low reflectivity and long life.

Noranda indicates that structure height probably would vary, depending on topography, from 30 to 90 feet. The distance between structures may vary from less than 200 feet to over 2,000 feet, depending on the route selected and terrain crossed. Tree clearing also may vary depending on span length and tree and structure height. Noranda has stated that it would work with the agencies to optimize pole height and span length to minimize concerns over tree clearing and visual considerations along any approved route and centerline.

The low point in the conductor sag would be 40 feet above the ground. Three conductors with a horizontal spacing of about 20 feet and a vertical spacing of 6.5 feet are proposed. A 0.5-inch static wire for protection against lightning strikes would be located at the top of each pole 17 feet above the top conductor.

Line construction would require use of both light and heavy equipment operated by a 23-man crew. Figure 2-17 shows typical construction activities and wire-stringing operations. The line would be designed and operated to comply with applicable Rural Electrification Administration and National Electric Safety Code standards. Noranda would adopt DNRC's Environmental Specifications (Appendix F) to guide line construction, operation and maintenance activities.

Most construction activity would be contained in the right-of-way, with major exceptions being access roads and conductor pulling and stringing. General



NOTE 1. ONLY THOSE TREES THAT FALL OUTSIDE ARC FOR FALLING TREES AND INSIDE ARC FOR CONDUCTOR SWING WILL BE REMOVED

NOTE 2. SEE DOCUMENT "GENERAL DESCRIPTION OF RIGHT OF WAY AND CLEARING REQUIREMENTS FOR PRIMARY (230kV) AND SECONDARY (13.2kV) LINES FOR EXPLANATION OF DIMENSIONS AND TERMS

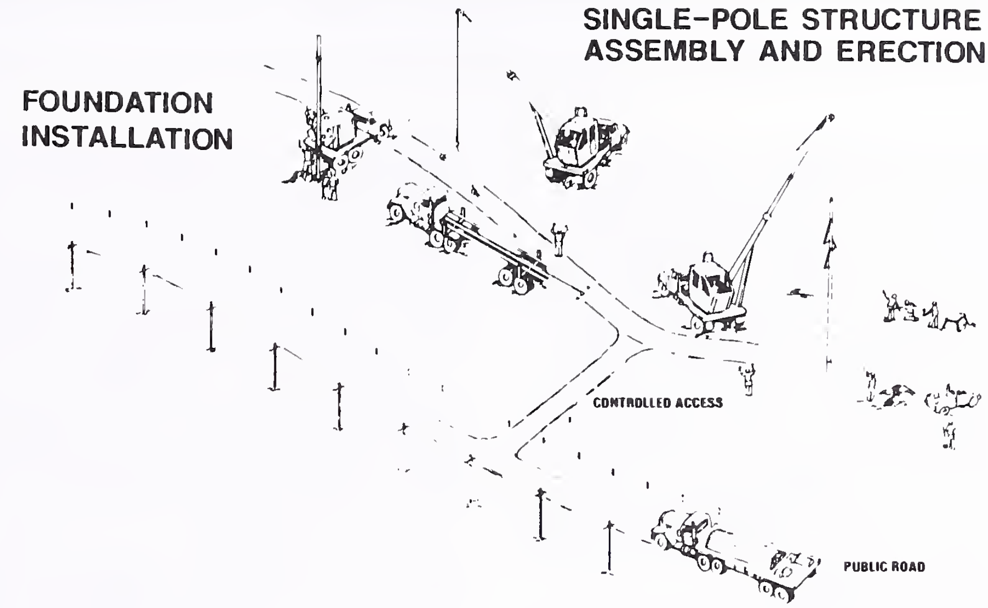
NOTE 3. MOMENTARY EXPOSURE ZONE

NOTE 4. BLACKENED GALVANIZED STEEL 95' MONOPOLE

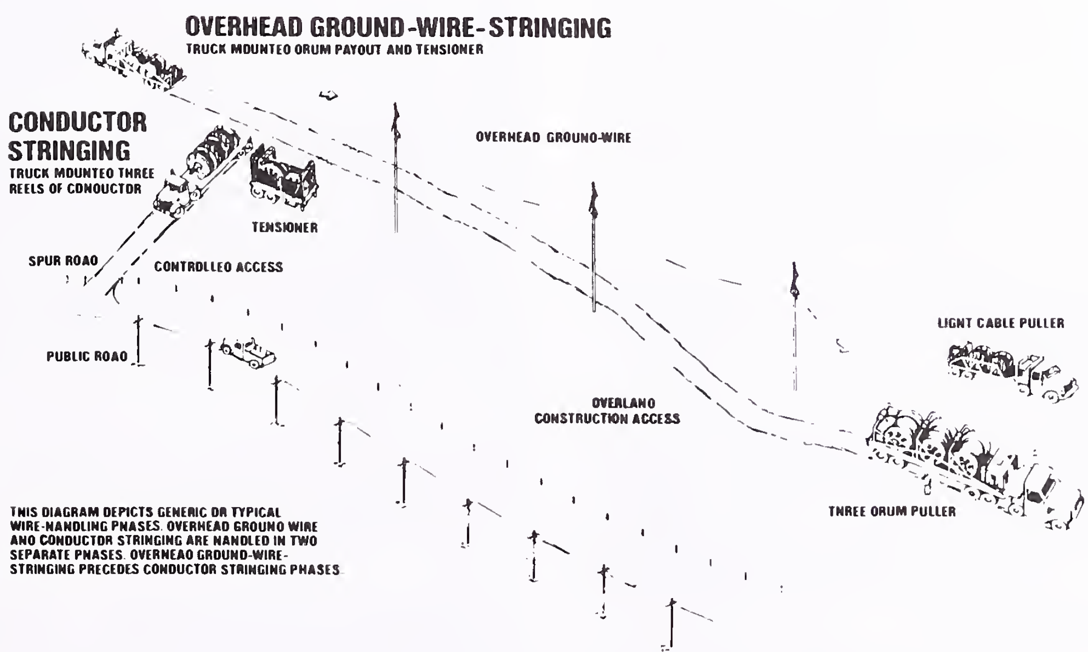
NOTE 5. COAL TAR EPOXY TREATMENT.

FIGURE 2-16.

CLEARING REQUIREMENTS FOR THE TRANSMISSION LINE



Typical Construction Activities



Basic Wire-Handling Equipment

FIGURE 2-17

Typical Transmission Line Construction Activity.

Source: Western Area Power Administration. 1986.

right-of-way clearing would be governed by safety, reliability, environmental, and cost considerations. A 100-foot right-of-way would be cleared as necessary along the full length. Additional tree clearing outside the 100-foot right-of-way would be necessary to prevent trees from falling into the line, or fires from flashovers where trees are too close to the conductor. This would produce a "feathered" edge on the right-of-way clearing, with the actual width of right-of-way clearing varying along the line (Figure 2-16). Final centerline placement would determine tree removal requirements.

Road construction. Existing roads would be used for construction access where possible, and primitive roads or spurs would be built where necessary. New roads would be 12- to 14-feet wide and cleared of all trees and shrubs. Wood refuse and cleared shrubs would be placed on the downhill edge of the road for erosion control. A primitive road within the right-of-way would be required for line stringing operations across side slopes greater than ten percent. On all new access roads, suitable topsoil would be moved uphill of the road for replacement following construction. Drainage for new temporary roads and stream crossing requirements for construction activities would be evaluated jointly before construction by the agencies and Noranda. Stream crossings would be constructed to meet KNF and Board requirements.

Ground disturbance necessary for some pulling and tensioning sites may extend up to 100 feet beyond the right-of-way boundary where the line makes an angle. These sites usually require an area up to 50 feet by 150 feet. The proposed route would require about eight of these sites.

Pole placement. Pole placement activity is expected to occur within 30 feet of the holes where the poles would be installed. Activities conducted outside the 30-foot radius would include framing conductor supports and establishing an operating location for the crane. The optimal crane operating conditions require that the crane be as close to the hole as possible but, because of uneven terrain at certain sites, cribbing with timbers under the crane outriggers would be necessary to level the crane. The need for the crane to be outside of the 30-foot radius probably would be the exception.

A small area next to the pole site would be covered by 1.5 cubic yards of backfill material brought in from offsite. This sand and gravel material would be placed within approximately 10 feet of the pole hole and used for backfill.

Where bedrock is encountered while excavating pole holes, a rock drill and compressor would be used to drill the rock. A hole would be blasted using explosives. Blasting would not expand the area needed for operations around the hole, but would increase the amount and duration of associated construction activity. It also would slightly affect the sequence and schedule of operations around those holes, extending the amount of time that the poles remain at the site before they can be set.

Operation and maintenance. Noranda has proposed using the Best Management Practices, listed in Appendix G, along with DNRC's Environmental Specifications (Appendix F). These measures provide the flexibility necessary to refine mitigation measures for protection of surface water and other resources on the basis of site-specific conditions that cannot be fully known until the final design stage.

Upon completion of line construction, Noranda would—

- scarify and reseed soil disturbed within the right-of-way;
- spread material removed from pole holes not used as backfill around the pole location and reseed;
- replace soil removed from new access roads back to the roadbed;
- reseed new access roads and place berms across them to prevent use by unauthorized vehicles; and
- remove berms where necessary to allow road use by line repair equipment and replace berms following repair completion.

Noranda would select a utility to operate and maintain the line. Annual line inspection would be conducted by helicopter to assess structural integrity and to identify maintenance needs. The conductors, insulators, and poles would be examined periodically by inspectors on the ground.

Land use in the right-of-way normally would not be restricted except for those activities that interfere with the line operation and maintenance. Line operation would not require any permanent employees, although Noranda would have a trained fire crew and would cooperate with the KNF and local fire departments in controlling forest fires in the area.

The proposed line is expected to have a life approximating that of the proposed mine although it could provide electrical service during the reclamation period. The nature of the loads and mine power requirements would not require expansion of the transmission line. Following completion of operations and reclamation, the transmission line would be removed using equipment similar to that used during construction. Reclamation at the end of the line's life would include removal of all facilities, and revegetating access roads, pole sites, and the right-of-way. Transmission line reclamation is further discussed under the *Reclamation* section.

Reclamation

Noranda's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KNF Forest Plan. Specific objectives include—

- protecting air, surface water and ground water permanently;
- removing potential hazards to protect public health and safety;
- maintaining public access in most of the project area;
- restoring wildlife habitat;
- designing a land configuration compatible with the watershed;
- reestablishing an aesthetic environment, with consideration of visual quality and recreational opportunity; and
- reestablishing a vegetation community appropriate for the post-mining land use.

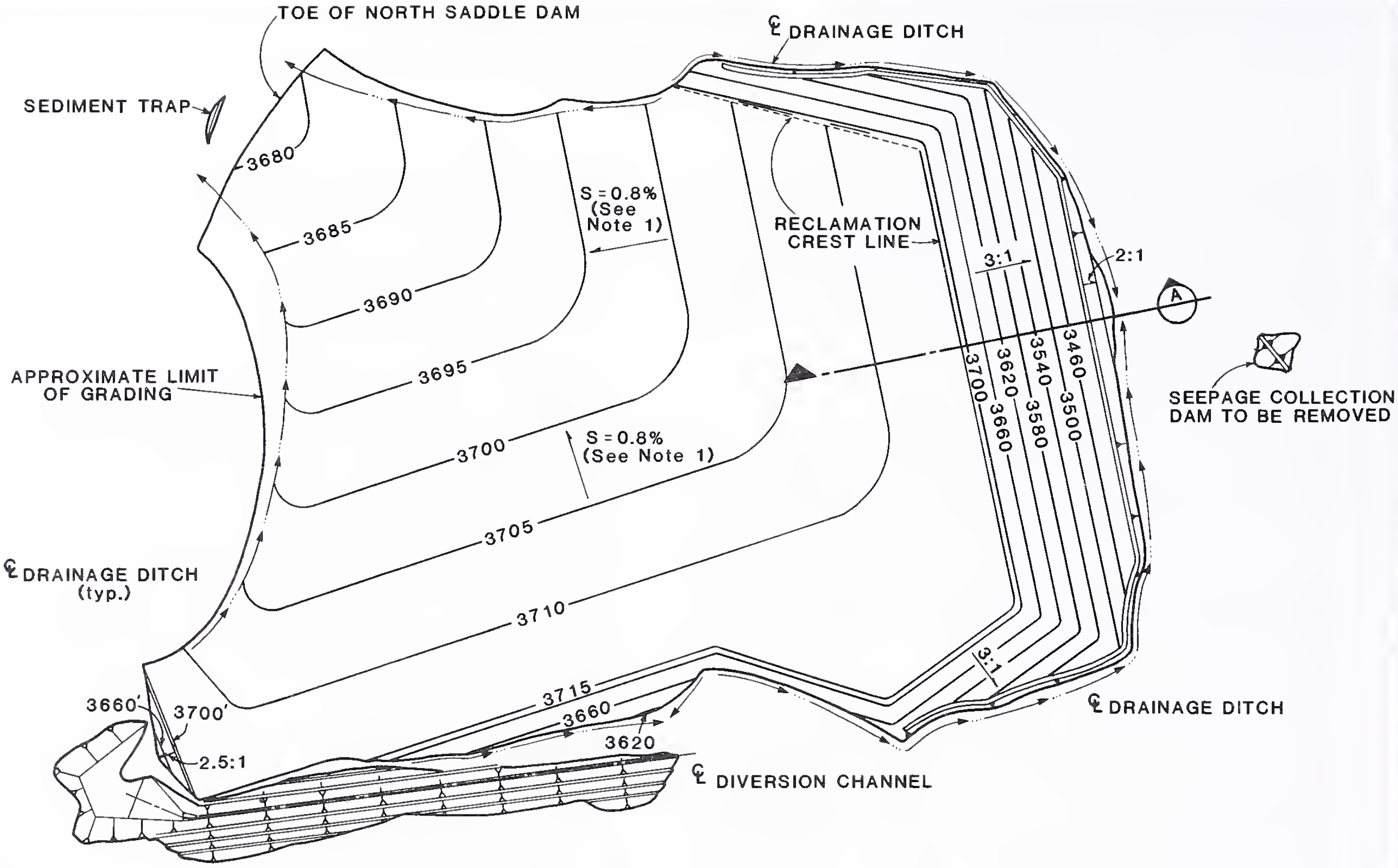
Noranda would accomplish these objectives by stabilizing disturbed areas during and following operations. Noranda has developed specific plans for each disturbed area, which are briefly described in the following sections.

Tailings impoundment. Components of the tailings impoundment would be reclaimed incrementally to minimize potential long-term erosion and maximize tailings dam stability. The reclamation plan would consist of the following—

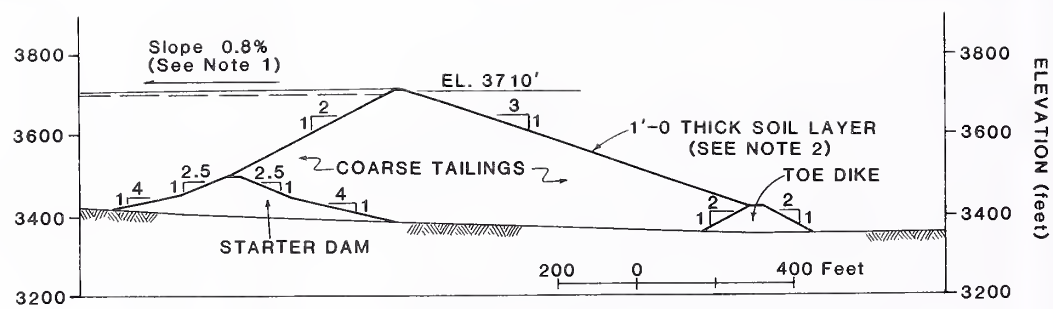
- forming a berm with tailings along south and east sides of the impoundment;
- spreading an average of six inches of coarse tailings on the impoundment surface;
- lowering the water level in the impoundment, then grading the surface;
- replacing topsoil (18 inches or 24 inches) and preparing a seedbed; and
- revegetating all disturbances.

The tailings impoundment would be reclaimed to the configuration in Figure 2-18. The side slopes of the impoundment would remain as built during the project's operational phase, and would be capped with a two-foot layer of topsoil and revegetated. The tailings berm formed along the south and east sides would be graded to the northwest at a 0.5 to 1 percent slope. Noranda anticipates that a shallow depression may form in the center of the impoundment due to tailings settlement. During grading activities, the depression would be filled with coarse tailings, mine waste rock, or material from the north saddle dam. Potential settlement of the pond surface would be estimated during final reclamation studies.

The north saddle embankment would be removed and the surface runoff from the impoundment would



POST-MINE TOPOGRAPHY



CROSS-SECTION A

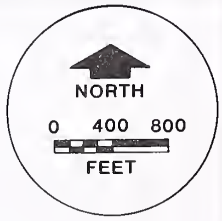
NOTES:

1. Final slopes may vary between 0.5% and 1.0%.
2. Surface to be seeded with grass.

Source: Morrison-Knudsen Eng., Inc. 1990a.

FIGURE 2-18.

POST-MINING TOPOGRAPHY — TAILINGS SITE IMPOUNDMENT



flow via a diversion ditch toward Bear Creek. A small check dam would be built just beyond the northwest end of the reclaimed impoundment. Sediment would be removed from behind the dam, if necessary.

The diversion structures above the reclaimed tailings impoundment, designed for the Probable Maximum Flood event, would remain, routing runoff into the permanent diversion channel. Seepage through the tailings embankment would continue following reclamation. The seepage collection dam would remain in place until water quality objectives are met. Seepage collected in the pond would be pumped to the tailings impoundment where it would evaporate or be used for irrigation. Following removal, the seepage collection dam would be graded to approximate original contour.

All mechanical facilities associated with the tailings impoundment, including the pipelines, would be removed. All areas associated with the impoundment would have soil materials replaced and revegetated following operations.

Noranda has recognized in the permit application that the tailings impoundment should be considered for designation by KNF as a "special management area". Noranda would cooperate with the agencies in developing appropriate post-mining management for the tailings impoundment area.

Plant site. All structures would be removed, and above- and below-grade features would be restored to a final topography shown in Figure 2-19. The patio would slope west to east at about five percent. The cut-and-fill slopes around the plant would be revegetated following construction. If the cut-and-fill slopes are not vegetatively stabilized by plant closure, they would be reduced to 50 percent by pulling fill into the cut and by grading the berm into the cut. Internal roads and parking areas would be graded to approximate original contours and revegetated.

Libby Creek adit site. Reclamation of the Libby Creek adit site would follow procedures described for the plant site. All structures would be removed, and above- and below-grade features would be restored to a final topography shown in Figure 2-20.

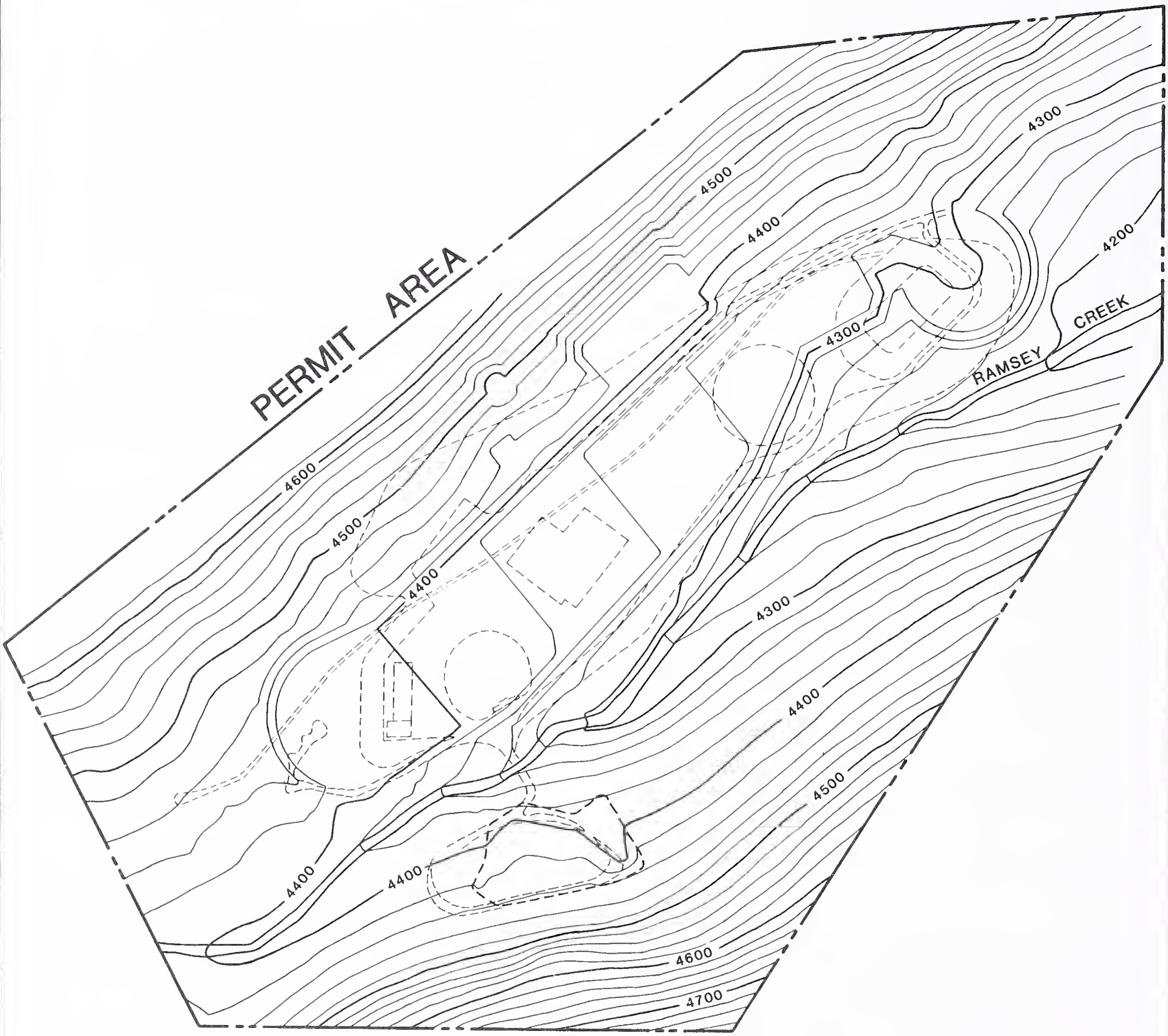
Adits. Adit portals would be permanently closed upon completion of operations. Closure techniques would depend on whether water is or would be produced at the opening. Dry openings would be sealed by backfilling waste rock from the portal patio.

Noranda would use water inflow data obtained during mining to predict the amount and quality of water expected from the adits. If it is determined water quality standards would be exceeded, based on this information, concrete or other types of adit plugs would be considered.

Waste rock and land application disposal areas. All waste rock is expected to be used in various construction activities. If construction requirements do not exceed waste rock production, or if more economical borrow material becomes available, one or more waste rock storage areas would remain. These areas would be graded to 50 percent slopes, top-soiled and revegetated. Other design characteristics of the waste rock areas, such as height or size, would be dependent on total volume remaining. Land application disposal areas would be revegetated.

Transmission line. Following construction, land on the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. Access roads not needed for maintenance would be recontoured, scarified, and reseeded. All permanent cut-and-fill slopes on maintenance roads would be seeded, fertilized, and stabilized with hydromulch, netting, or other methods. Drive-through dips, open-top box culverts, waterbars, or crossdrains would be installed on maintenance roads to prevent erosion; unauthorized traffic would be blocked with appropriate structures.

At the project end, the line would be abandoned. Structures, conductors, insulators, and hardware would be removed from the right-of-way. All disturbed areas would be recontoured and revegetated.

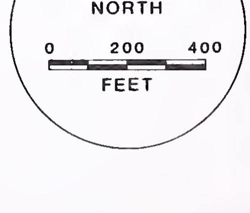


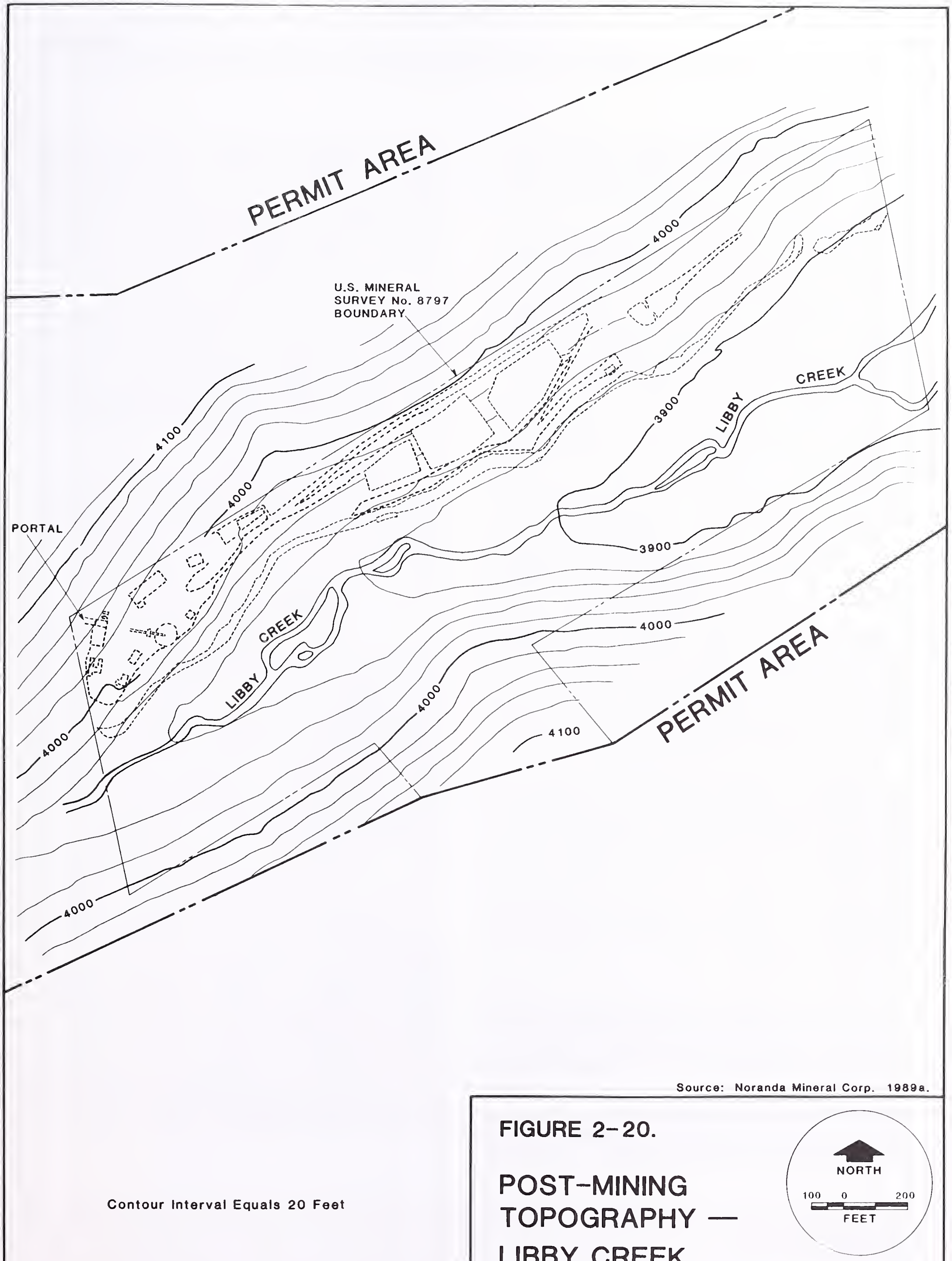
Contour Interval Equals 20 Feet

Source: Noranda Minerals Corp. 1989a.

FIGURE 2-19.

POST-MINING TOPOGRAPHY — RAMSEY CREEK PLANT SITE





Source: Noranda Mineral Corp. 1989a.

FIGURE 2-20.

POST-MINING TOPOGRAPHY — LIBBY CREEK ADIT SITE

Where culverts are removed, streambanks would be recontoured and reseeded. Shrubs, such as alder or willow, would be planted on streambanks to reduce bank erosion during high streamflow.

Roads. The Bear Creek access road, from U.S. 2 to the Bear Creek bridge, would remain 20- to 29-feet wide. Soil would be salvaged from disturbed areas and redistributed on cut-and-fill slopes where possible. The main access road from the Bear Creek bridge to the plant site would be returned to a 15-foot width, unless the KNF should want a wider road.

The road following the tailings slurry pipeline would be stabilized with revegetation mixture after construction; the road would be removed following operations, topsoiled and revegetated. The temporary crossing from the plant site to the Ramsey Creek portal patio would be removed following bridge construction. Any disturbance along Ramsey Creek to the Libby Creek adit road would be reclaimed following construction activities.

Soil salvage and handling plan. Noranda would salvage and replace soils on most disturbed areas. Merchantable trees would be purchased and harvested on all areas to be disturbed prior to soil salvage. Noranda would schedule timber removal in cooperation with the KNF.

The suitability of soils proposed for salvage was determined from physical and chemical data collected during the baseline soil survey (Western Resources Development Corp., 1989b). Soils containing more than 50 percent rock fragments are generally unsuitable for salvage. Some soils with rock fragments up to 60 percent, however, would be salvaged to provide erosion protection on the impoundment dam.

Some soils would be salvaged in two lifts (or layers), while only the surface layers of others would be salvaged (Table 2-8). Not all soils suitable for reclamation would be salvaged. Suitable layers of some soils, such as the Andic Cryochrepts or the Andic Dystrochrepts, would not be salvaged because other suitable soils would be available to meet the proposed replaced soil quantities (Table 2-9). Steep slopes or a high water table would preclude the salvaging of some soils. Total soil salvage acreage does not equal total disturbance acreage (Table 2-1) because soil would not be salvaged from stockpile sites, powerline corridors, or areas where soil has already been removed (such as existing roads).

Soil stockpiles would be constructed with 40 percent side slopes and 33 percent sloping ramps where possible. As stockpiles reached their design capacity, they would be stabilized and seeded during the first appropriate season following stockpiling. Fertilizer and mulch would be applied as necessary to promote successful revegetation.

Soil would be salvaged and replaced without stockpiling when feasible, primarily at the tailings impoundment, or stockpiled as close as possible to

Table 2-8. Soil suitability and proposed salvage depths.

Soil	Suitable depth	Proposed salvage depth Lift 1	Lift 2
	———	(in.)	———
Andic Cryochrepts	29	18	0
Andic Cryochrepts	20	18	0
Andic Dystrochrepts	65	10	12
Andic Dystrochrepts	9	9	0
Andic Dystrochrepts, moderately deep	11	11	0
Andic Dystrochrepts, deep	9	9	0
Andic Dystrochrepts	9	9	0
Typic Humaquepts	15	15	0
Typic Cryochrepts/ Cryumbrepts	0	0	0
Typic Cryorthents	0	0	0
Typic Glossoboralfs	33	8	25
Cumulic Humaquepts	9	9	0
Typic Paleboralfs	24	9	15

Source: Noranda Minerals Corp. 1989a. V. 1, pp. I-81*ff* and V. 2, pp. III-36*ff*.

redistribution sites. Compaction and handling would be minimized as much as possible. Topsoil replacement depths would average about 24 inches on the impoundment dam and 18 inches on all other disturbed areas. Soil would not be redistributed on access road slopes with exposed bedrock.

Prior to redistribution, compacted areas (especially the adit portal areas, roads, soil stockpile sites, and facilities area) would be ripped to reduce compaction. Ripping would eliminate potential slippage at layer contacts and promote root penetration. Soil salvage and redistribution would occur throughout the life of the operation

Revegetation. Seed mixtures and rate selection were based on the expected moisture, temperature, and soil conditions, as well as types of species available for revegetation found in existing vegetation communities. Two mixtures have been developed—one dominated by species typically found in moist, relatively cool sites, and one with hardier species.

Seeding rates were designed to average about 90 to 100 live seeds per square foot for drill seeding and roughly twice that for the broadcast rate. Drill seeding would occur on slopes of 33 percent or less. Rocky slopes, areas where organic debris has been spread, or slopes greater than 33 percent would be broadcast or hydroseeded. Seed mixtures may be modified due to limited species availability, poor seed quality, site differences, poor initial performance, or advances in reclamation technology. Forbs would not be used in seed mixtures used on roadsides to avoid attracting bears.

Fertilizer application rates would be based on soil tests; phosphorus fertilizer would be applied prior to seeding, and nitrogen fertilizer would be applied in growing seasons subsequent to seeding. On slopes of 33 percent or less, the seedbed would be disced and harrowed. After seeding, straw mulch would be applied and anchored at 0.5 to 1.5 tons per acre, depending on the seeding method. Some hydroseeded areas would be mulched with a cellulose fiber mulch and a tackifier (a material used to adhere the mulch to the ground surface).

Tree and shrub seedlings would be planted in selected areas of the plant site, the Libby Creek adit area, and the tailings impoundment area. Shrubs and trees would not be planted on soil stockpile sites and portal patios, along road corridors, or in the powerline corridor, relying instead on natural revegetation. Stocking rates would be 435 trees per acre and 200 stems per acre for shrubs. Seedlings would be planted either continuously in strips on steeper slopes or in highly visible areas, or in randomly placed groupings on level to gently sloping areas. Containerized seedlings would be used when available; stocking rates would be increased when bare-root stock is used.

Interim revegetation would take place on certain disturbed areas (i.e., roads, stockpiles, powerline, pipelines, and other areas) to reduce erosion and sedimentation. These areas would be broadcast seeded with the interim seed mixture, mulched and fertilized as necessary. As the tailings dam is increased in height, only those slopes where no

Table 2-9. Soil salvage acreages and volumes.

Facility	Acreage	Volume (yd^3)
Tailings impoundment	595.3	1,895,200
Borrow Area C	65.0	157,300
Borrow Area D	142.0	343,640
Seepage collection pond	13.3	44,900
Diversion ditch	44.8	57,100
Plant site	44.9	104,900
Libby Creek adit site	18.7	41,700
Waste rock storage area and LAD area no. 1	58.0	207,400
LAD area no. 2	20.0	88,700
Total	1,003.0	2,940,840

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-37*ff*.

additional tailings deposition is anticipated would be reclaimed using the permanent seed mixture. All other unreclaimed disturbances would be reclaimed within two years after mining completion.

Erosion Control

Wind and water erosion control measures are detailed throughout Noranda's permit application. These measures are summarized in Table 2-10. During facilities construction, operation and closure, Noranda would use Best Management Practices (BMPs) to control erosion. Proposed Best Management Practices are presented in Appendix G. Noranda, along with the agencies, would monitor implementation of BMPs to ensure erosion and sedimentation is minimized. BMPs would be modified as necessary in response to site specific conditions.

Proposed air emission control techniques are described in Noranda's air permit application (TRC Environmental Consultants, Inc., 1989). These measures involve—

- mechanical practices to minimize fugitive dust;
- grading and soil handling techniques to enhance stability;
- hydrologic systems to control runoff and sedimentation; and
- revegetation practices to provide a stabilizing cover.

Tailings may blow during summer and fall when the impoundment surface or the tailings dam face is sufficiently dry to allow wind erosion. Sprinkler irrigation and/or revegetation would be used to reduce windblown tailings and provide interim stabilization. Soil replacement and revegetation would provide long-term tailings stabilization.

Interim Monitoring Plans

Noranda has implemented an interim monitoring program that provides a continuation of data gathering for aquatic, and surface and ground water resources in the project area. The program involves collecting seasonal resource information, thereby extending the database beyond the one-year baseline investigation. The program encompasses the period between the completion of the baseline studies and the construction/development phase of the project. Noranda has submitted its summary report on the interim hydrology monitoring program for 1989, 1990, and 1991 to the agencies (Chen-Northern, Inc., 1990, 1991a, 1992a). The 1990 and 1991 aquatics interim monitoring reports also have been submitted (Western Technology and Engineering, Inc., 1991b, 1992). The 1992 hydrology plan also has been prepared (Chen-Northern, Inc., 1992b).

Hydrology. The surface water monitoring program includes water sampling, field measurement, and flow measurement of surface waters in the Libby Creek drainage. Sampling stations on five drainages in the project have been established; some stations also serve as aquatic monitoring stations (Table 2-11). Monitoring stations are shown in Figure B-2 in Appendix B.

Table 2-11. Interim monitoring sampling locations.

Drainage	Monitoring station designation: Surface water	Aquatics
Libby Creek		
	LB 200	L10
	LB 300	L9
	LB 1000	L3
	LB 2000	–
	LB 3000	L1
Little Cherry Creek		
	LC 100	–
	LC 800	LC1
Ramsey Creek		
	RA 100	–
	RA 200	–
	RA 550	Ra2
Poorman Creek		
	PM 1000	Po1
Bear Creek		
	BC 500	Be2

Source: Chen-Northern, Inc. 1992b.
Western Technology and Engineering, Inc. 1992

Table 2-10. Erosion control practices proposed by Noranda.

Hydrologic practices	Soil erosion control practices	Revegetation practices
Constructing drainage and diversion systems, including energy dissipators and sediment traps at all disturbance sites to control runoff and sedimentation	Salvaging of soils concurrently with disturbances to the extent possible	Including rapidly developing and sod-forming plant species in seed mixtures
Diverting naturally occurring runoff around the plant site and Libby Creek adit site	Direct haul soil handling (soil salvage and immediate redistribution) whenever feasible	Revegetating in the first appropriate season after soil redistribution
Collecting all water originating within the plant site and routing to a drainage sump for later use	Periodic watering and sprinkling of all unpaved roads with dust suppression agents	Applying mulch (or tackifiers on hydromulched areas)
Intercepting soils eroding from dam faces	Using a sprinkler system, if necessary, to control blowing tailings	Protecting revegetated areas disturbed by banning traffic until vegetation is established
Stabilizing and revegetating rills and gullies	Spraying coarse ore storage area with water to control emissions	Stabilizing disturbed areas with interim revegetation
Installing benches at 15 to 25 feet intervals on cut-and-fill sideslopes at the plant site	Covering all transfer points at concentrate loadout	Planting trees on the tailings impoundment face and surface
Constructing erosion bars on unpaved roads	Inspecting slopes throughout the operation to monitor slope stability	Planting shrubs on road cut-and-fill slopes if necessary
Placing riprap on the dam crest and uppermost part of the tailings impoundment dam face	Implementing interim and long-term revegetation of soil stockpiles to minimize wind and water erosion	Broad-cast seeding of slopes exceeding 33 percent
Lining the Little Cherry Creek diversion channel with two feet of riprap and placing rockfill bars or gabions to dissipate flow energy	Using Best Management Practices to control sediment (Appendix G)	
Placing windrows of woody debris parallel to slope contours at the bases of long fills		
Minimizing right-of-way clearing to reduce the total area susceptible to erosion		

Source: Noranda Minerals Corp. 1989a and 1989c.

Because of access restrictions by a private landowner, several stations included in the 1989 and 1990 interim monitoring programs have either been removed or relocated. Station RA 600 has been relocated several hundred feet upstream on Ramsey Creek and renamed RA 550. Station LC 600 has been removed and replacement station LC 800 is located downstream on Little Cherry Creek. Stations PM 1000 and LB 3000, sampled only during the baseline year, were sampled again in 1991. Station PM 1000 also has been moved slightly upstream to avoid landowner conflict. A station on Bear Creek, BC 500, was added in 1991. All interim monitoring stations would be used in the operational monitoring plan (Figure B-2 in Appendix B).

In the 1992 interim monitoring, Noranda is conducting sampling and flow measurement at these stations three times during the year. Samples are collected and analyzed monthly for total suspended solids (TSS). Surface water samples are analyzed for many of the same parameters analyzed in the baseline study (Chen-Northern, Inc., 1989). Molybdenum and fluoride have been dropped from analysis because they were below detection limits for the three sampling years and do not have aquatic life standards. Detection limits for metals for 1992 interim monitoring are shown in Table 2-12; all parameters are shown in Appendix B. Several metals will be analyzed once on samples collected during low flow (August). Noranda is using the quality control program and general sampling procedures of the baseline study.

Lake levels in Rock Lake and Saint Paul Lake are also monitored. The proposed monitoring program focuses on identifying lake water levels during high and low water level periods. Water levels are measured from an established level on the lake shore and a photographic record would be obtained.

Monitoring wells included in the interim monitoring program are five wells in the Ramsey Creek LAD area, four wells in the Libby Creek adit area, and seven wells in the tailings impoundment area. Measurement of static water levels occurs during March and September. Samples are collected from these wells and analyzed for the same parameters which were used during the baseline investigation (Chen-Northern, Inc., 1989). Detection limits shown in Table 2-12 are used.

Aquatics. In the interim aquatics monitoring program, periphyton (algae) and macroinvertebrates (aquatic bugs) are sampled at the eight sampling locations shown in Table 2-11. Sediment accumulation in each stream is visually assessed at each sampling station.

Operational and Post-Operational Monitoring Plans

Noranda also has proposed monitoring programs which would be implemented during operations.

Table 2-12. Noranda's proposed detection limits for metals—hydrology monitoring program.

Metal	Detection limit
Aluminum	0.1
Antimony	0.002
Arsenic	0.005
Barium†	0.012
Beryllium†	0.001
Cadmium	0.0001
Chromium	0.004
Copper	0.001
Iron	0.05
Lead	0.0007
Manganese	0.02
Mercury	0.0002
Nickel	0.002
Selenium†	0.0005
Silver	0.0002
Thallium†	0.003
Zinc	0.02

Source: Chen-Northern, Inc. 1992b; all detection limits in units of mg/L.
†These metals will be analyzed once on samples collected during low flow (August).

Noranda would conduct operational and post-operational monitoring and provide monitoring results to the agencies in an annual monitoring report. Monitoring programs for hydrology, aquatic life, tailings dam stability and revegetation, are included in Noranda's permit application. The proposed programs are summarized in the following sections.

Hydrology. Surface and ground water would be monitored during operations. Sample sites and detection limits used in the interim monitoring plan would be used (Tables 2-11 and 2-12). Ground water wells have been installed for baseline and interim monitoring in the proposed tailings impoundment area and Ramsey Creek LAD area. In September, 1991, Noranda installed five additional monitoring wells in the Ramsey Creek LAD area. These new wells and those established under baseline and interim monitoring will be used for operational monitoring. Proposed monitoring well locations include—

- Up-gradient and down-gradient of the plant site, and down-gradient of the Ramsey Creek LAD area;
- A series of monitoring wells associated with the tailings pond pressure relief system and down-gradient of the seepage collection pond; and
- Down-gradient of the Libby adit portal and water disposal area.

Noranda would develop a post-mining hydrologic monitoring program in coordination with the agencies prior to mine closure. Noranda would submit the plan to the agencies for review and approval before ceasing operations. The monitoring program would include surface and ground water sampling, primarily down-gradient of disturbed areas. Wells in the tailings impoundment and plant site areas and surface water stations on Ramsey, Libby, and Little Cherry creeks would continue to be sampled. Hydrologic monitoring would include periodic ground water level and streamflow measurements. Any adit discharge would be monitored for quality and flow. Water levels in the tailings impoundment would be measured periodically.

Aquatics. Noranda would monitor aquatic macroinvertebrate populations at eight sampling locations in the project area. Sampling locations would include one each in Ramsey, Poorman, Little Cherry and Bear creeks, and four in Libby Creek. Noranda would sample each station during the spring, summer, and fall. Besides the sampling described in the interim monitoring plan, fish populations would be estimated and fish tissue would be analyzed. Noranda would monitor fish populations at three-year intervals in a single appropriate stream reach, located slightly upstream of Station L1 (LB-3000). During the first year of operation, ten rainbow trout greater than four inches in size and ten adult sculpin would be collected from Libby Creek between Stations L1 and L3. Collections would be completed during the late summer to early autumn low-flow period. Tissue samples, including homogenized flesh and skin from each fish, would be analyzed to determine lead and mercury concentrations. Subsequent to the first year's monitoring, additional tissue analysis would be conducted every three years. Noranda would tabulate sampling data and present the monitoring results in an annual report.

Tailings dam stability. Tailings dam stability would be monitored during the operating period and after the mill operation ceases. Monitoring would consist of visual inspection, water level measurements, seepage quantity measurements, and elevation surveys. If excessive artesian pressures are detected at the dam location, whether by monitoring well readings or by observation of soft seepage areas, sand boils, or sloughing of the dam toe, Noranda would promptly treat the distressed areas. Treatment could include additional relief well installation, or placement of suitable fill over these areas to provide buttressing. Prompt implementation of remedial measures to relieve localized distress would be a maintenance activity.

Revegetation. The vegetation cover, species composition, and tree planting success would be evaluated during the first year following reseeding or replanting. In addition to a general evaluation,

Noranda would conduct a detailed reclamation evaluation at sites representative of various types of disturbance. The following would be evaluated—

- plant species responses;
- success of steep, rocky slope reclamation;
- soil redistribution depth;
- soil rock fragment content;
- effects of fertilizer rates;
- tree planting techniques and stocking rates; and
- differences between bare-root and containerized planting stock.

Soils would be tested for macronutrient content and appropriate fertilizers formulated. Prior to soil redistribution, tailings and waste rock would be sampled for revegetation constraints. Analytical parameters would include texture, rock fragment content, pH, and acid-base accounting. Depending on pH values, selected trace elements would be analyzed. Rills or gullies on reclaimed areas would be stabilized and reseeded. Surface water control structures would be maintained until areas are stabilized to prevent excessive erosion.

For two years, revegetated areas would be protected by fencing where necessary from vehicle and livestock use. Wildlife damage control would include selective fencing, chemical repellents, or terminal bud protection coverings. Noxious weeds would be mechanically controlled or selectively sprayed during the life of the operation to reduce invasion of reclaimed areas. A noxious weed control plan would be developed in accordance with the Lincoln County Weed Board and, where applicable, with KNF guidelines.

Economic Impact Mitigation Plan

Noranda has prepared a Hard Rock Mining Impact Plan which describes how the Montanore Project would affect local government services, facilities, costs and revenues. The plan specifies the measures Noranda would undertake to mitigate adverse fiscal impacts to local government units. The plan was made available to the public after publication of the DEIS. Sanders County filed a formal objection to the Impact Plan in February 1991. The appeal was reviewed by the Hard Rock Mining Impact Board, which held an informal contested case hearing in July 1991 to clarify terms of the disputed Impact Plan. The Board ruled on the Sanders County objection in September 1991. The Board's order clarifies the taxable valuation distribution among local government affected by the project. Noranda revised the Impact Plan to reflect the Board's order, and the Board approved the plan in April 1992. Noranda will be required to abide by terms of the Impact Plan as part of its DSL operating permit terms. The *Socioeconomics* section of Chapter 4 discusses the Hard Rock Mining Impact Plan in greater detail.

Wetlands and Fisheries Mitigation Plan

Noranda completed wetlands mapping in all areas in the mine area and selected areas along the transmission line corridor. Based on this mapping, the Montanore Project would affect wetlands resources in the tailings impoundment area, along the access road, and along the transmission line corridor. These resources are described in detail in Chapter 3—*Waters of the United States and Wetlands*.

Noranda has prepared a mitigation plan to address wetlands and fisheries impacts (Noranda Minerals Corp., 1992b). The mitigation plan proposes to construct new wetlands and expand existing wetlands within the project permit area (on-site) and in the vicinity of the project area (off-site). Fisheries mitigation would occur at Howard Lake and Midas Creek. The proposed mitigation plan is designed to—

- provide mitigation for wetlands impacts on a "one-for-one" basis;
- replace lost wetland functions and values at on-site and off-site locations as closely as possible;
- implement mitigation concurrent with wetland loss;

- establish wetlands with a productive natural vegetation and a supportive hydrologic regime that would achieve functioning replacement wetlands within two to five years following implementation;
- minimize required maintenance;
- establish a monitoring plan; and
- develop a mitigation contingency plan.

Noranda has identified approximately 44.6 acres of possible wetland mitigation areas (Figure 2-21) Noranda's intention is to replace wetlands on a one-for-one basis. Therefore, not all the identified 44.6 acres would be developed into wetlands. Instead, Noranda would determine through additional studies which of these sites best meets the stated objective of one-for-one replacement (14.4 acres of disturbed wetlands). The following sections describe Noranda's mitigation plan.

On-site wetlands mitigation. On-site mitigation consists of about 8.8 acres of potential wetlands mitigation within the proposed permit area (Figure 2-21). Mitigation sites are proposed for the Little Cherry Creek diversion dam, and two areas downstream of the Little Cherry Creek tailings impoundment.

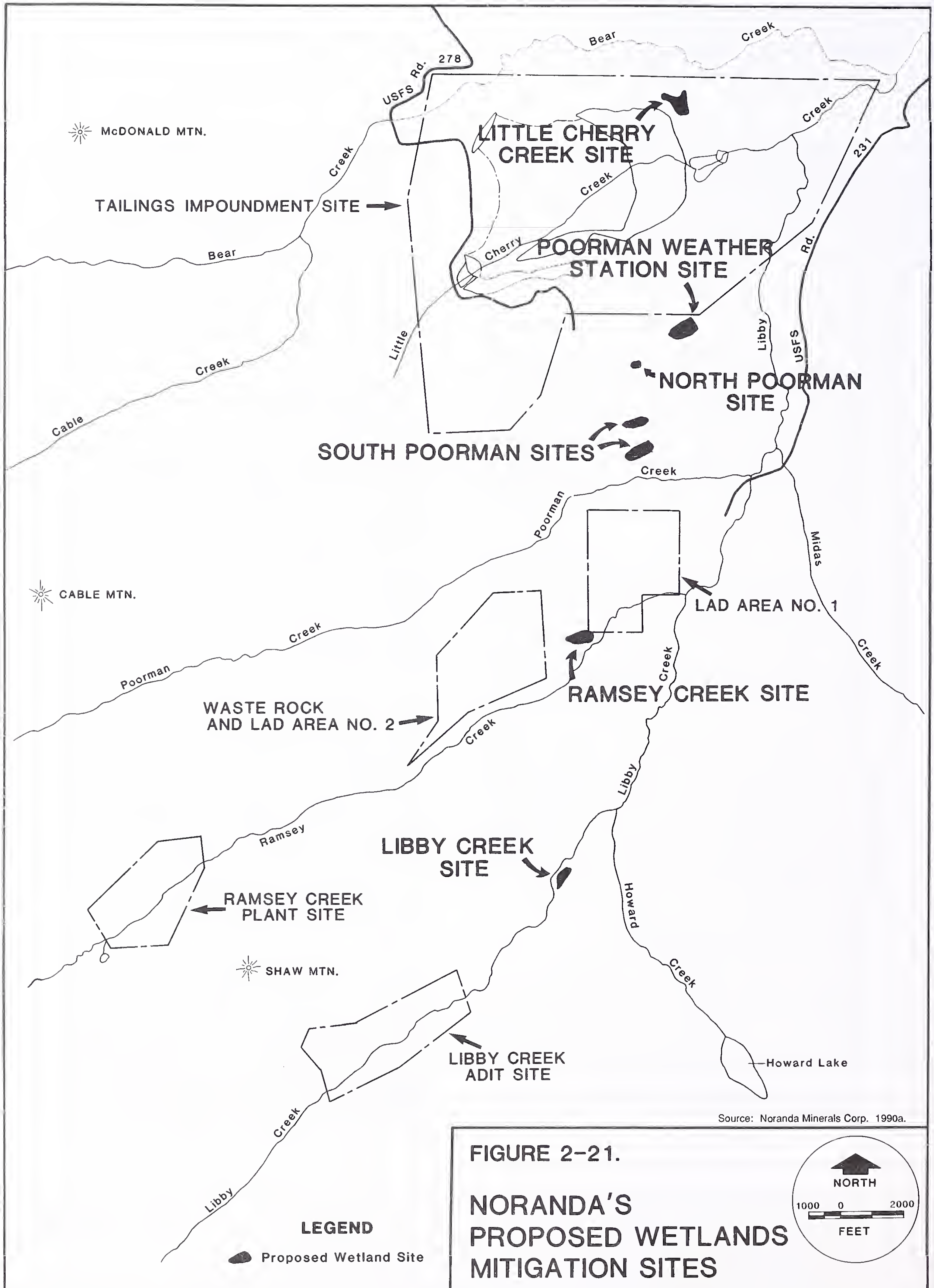
Little Cherry Creek would be diverted above the tailings impoundment to convey surface water around the impoundment. The diversion includes a dam and diversion channel. Since the diversion channel would be constructed at the beginning of operations, mitigation would be concurrent with wetland losses. Design of the diversion channel would include—

- reduction of surface area and depth of the open water component at the diversion dam;
- creation of shallow water zones, less than three feet deep, and herbaceous emergent wetlands within the diversion;
- design of a "normal" flow channel within the diversion channel;
- creation of undulations within the channel to form pools during low flows;
- evaluation of channel floor conditions to determine surface water loss to groundwater, and implementation of procedures to reduce surface water loss;
- salvage of wetland soils from the impoundment disturbance area and placement within the diversion channel;
- placement of a layer of soil and smaller sized rock (three to six inches) over larger riprap to reduce soil infiltration and provide a better rooting substrate; and
- construction of flow barriers down drainage to dissipate energy and create small pools.

The diversion channel is designed to provide hydrologic functions and values similar to those provided by the conifer-dominated wetlands in riparian areas. Noranda anticipates 1.6 acres of wetlands would be created in the diversion channel.

Two mitigation sites are proposed in the Little Cherry Creek drainage downstream from the tailings impoundment. One site, not specifically identified, would use ground water captured by pressure relief/seepage collection wells as a water source to create and maintain a wetland. Flows from selected wells (approximately 30 gallons per minute) would be directed down low gradient channels constructed to allow water to flow between and collect in a series of depressions. Hydrophytic vegetation would be established along the channels and on the depressions. A complex of herbaceous/shrub wetlands of about five acres would be created by directing the flows of the pressure relief wells. These wetlands are designed to replace the functions and values provided by existing herbaceous/shrub wetlands.

The other site in Little Cherry Creek is along the north side of the proposed impoundment, on lands owned by Champion International and leased to Noranda. This area contains a small existing wetlands complex. Noranda would increase the size of the existing wetlands through small excavations and dams that would retain water longer. Noranda also might use water from the pressure relief/seepage collection wells, if needed. Approximately 2.2 acres



Source: Noranda Minerals Corp. 1990a.

FIGURE 2-21.

NORANDA'S PROPOSED WETLANDS MITIGATION SITES

of additional shrub-dominated wetlands might be developed at this site.

Off-site wetlands mitigation. Approximately 35.8 acres of potential wetlands mitigation sites have been identified near the project area, but outside the permit boundaries. This includes three sites in the Poorman Creek area, one site within the Libby Creek Recreation Gold Panning Area, and along Ramsey Creek near the land application disposal areas. The Poorman sites include South Poorman, North Poorman, and Poorman Weather Station sites.

The proposed South Poorman mitigation site is adjacent to an existing 5.9 acre wetland site. It would consist of approximately 1.4 acres of new wetlands on the north side of this existing site, and 8.3 acres immediately south of the existing wetlands. The North Poorman site is adjacent to and north of a small existing wetland. Approximately 3.4 acres of additional wetlands would be developed at this site. The Poorman Weather Station site is not within an area of existing wetlands, and has no well defined drainage. Approximately 14 acres of new wetlands would be developed at this site. All three Poorman sites have soils and terrain similar to that of the proposed Little Cherry Creek impoundment site. Wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. The shallow ponds created would have emergent vegetation and islands to provide breeding habitat for waterfowl, amphibians, and reptiles. The intended functions and values would be similar to those of sedge-dominated wetlands. Artesian wells would be developed to supply water if natural runoff is insufficient to maintain hydrophytic vegetation.

Approximately two acres of newly constructed wetlands would be developed at the Libby Creek Recreation Gold Panning Area. Portions of the existing coarse placer piles would be removed, recontoured to expose ground water, and revegetated. These new wetlands would be shrub and forb dominated initially, but would eventually become conifer dominated.

The Ramsey Creek site is located near the proposed land application disposal areas. It is part of an existing human-made wetland area, and would be expanded by spreading out streamflow that feeds the site. Noranda estimates this site could be expanded by an additional 6.7 acres.

Wetlands mitigation monitoring. The goal of the wetland mitigation plan is to replace wetland functions and values which would be lost as a result of the project. To determine the success of the mitigation, Noranda would initiate a monitoring program immediately after construction of wetlands to assess vegetation growth, hydrological conditions, wildlife use, and integrity of constructed wetland elements.

Vegetation growth would be monitored in June and August following the first growing season. Species composition and canopy coverage would be recorded for constructed wetland communities. Relative amounts of seeded and non-seeded "volunteer" species would be recorded. If seeded species do not become established following the first growing season, supplemental seedings and transplanting would be undertaken. If noxious weeds invade reclaimed areas, they would be removed by mechanical methods.

Noranda would conduct vegetation monitoring each August for five years to ensure wetland plant communities predominate. The wetland status of reclaimed plant communities would be assessed by following the methods described in the current federal wetland manual.

Wildlife use of wetlands would be monitored in the spring and late summer for five years after construction. Spring monitoring would assess the use of wetlands by reptiles, amphibians, and waterfowl as breeding habitat. Late summer monitoring would determine the use of wetlands as feeding and water areas for big game and other wildlife.

The hydrologic status of wetlands would be monitored during spring and fall. Surface water depth would be recorded. If no surface water is present, test holes would be excavated to determine the depth of free water and saturated soil.

Constructed portions of wetlands, such as berms and channels, would be observed in spring and fall to ensure that they have not eroded or become non-functional. Any structural problems would be corrected as soon as possible.

Noranda would prepare and submit a yearly report to the KNF addressing the status of the wetland mitigation program. If mitigation is not progressing as planned, an interagency committee consisting of representatives of the KNF, the Environmental Protection Agency, and the Corps of Engineers would be convened to address remedial measures or to specify additional mitigation measures.

Fisheries mitigation. The effects to Little Cherry Creek would be mitigated by fishery enhancement projects at Howard Lake and Midas Creek. Fisheries enhancement of Howard Creek would consist of excavating organic material and fine sediment from the stream channel and replacing it with gravel suitable for trout spawning. Logs, boulders and other materials would be placed in the stream to provide additional fish habitat. Streambanks would be recontoured and revegetated with alder and willow, and lined with riprap where required.

Noranda proposes to introduce a spawning population of either rainbow trout or westslope cutthroat in Midas Creek. Although Midas Creek has suitable spawning habitat, it supports little or no trout spawning.

Grizzly Bear Mitigation Plan

The Montanore Project would affect existing grizzly bear habitat. These effects are detailed in Chapter 4—*Wildlife*. Noranda has prepared a mitigation plan to address these impacts. The plan consists of three components—

- habitat replacement/habitat enhancement;
- mortality control; and
- plan management.

Habitat protection/habitat enhancement. Noranda would protect existing habitat, or increase the effectiveness of existing habitat to compensate for habitat affected by the Montanore Project. Noranda would cooperate with a proposed Management Committee (see *Plan Management* section) in selecting the measures necessary to compensate for the habitat loss. Habitat protection would be accomplished through a combination of—

- road closures;
- purchase of private lands by Noranda and establishment of conservation easements during the project life; and/or
- acquisitions of conservation easements on other private lands during the project life.

Noranda would compensate for habitat disturbance through either protection or enhancement of existing habitat. Noranda would be responsible for purchasing all land and conservation easement acquisitions and for managing all lands. Before acquiring any land to mitigate or compensate for habitat loss, Noranda would study each prospective parcel to determine its habitat value. All prospective parcels for acquisition would be in identified grizzly bear recovery areas in the Cabinet-Yaak Ecosystem.

Lands to be acquired would be selected by the Management Committee based on capability to provide high habitat values, enhance grizzly bear use of existing habitat, improve mobility of bears throughout the Cabinet-Yaak Ecosystem, or reduce mortality risk. The proportion of habitat units that would be mitigated by road closure and habitat acquisition has not been precisely determined, but Noranda envisions each component would provide about 50 percent of the necessary habitat units (refer to *Wildlife* section in Chapter 4 for impact assessment).

Noranda also proposes that the KNF close several National Forest System roads on either a seasonal or year-round basis to increase habitat values. Road closures would be implemented in conjunction with habitat acquisition and protection to provide the necessary grizzly bear mitigation. Noranda has identified about 18 miles of National Forest System road that could potentially be closed on a year-round basis and an additional 20.1 miles of National Forest System road that could be closed on a seasonal basis from April 1 through June 30 each year (Figure 2-22). Noranda believes, however, that it would be necessary to close only 11.1 miles of road to mitigate all habitat unit losses. Of the 11.1 miles, 7.1 miles would be year-round closures and 4.0 miles would be closed in spring and early summer. The four roads that Noranda has identified as priorities for closure are the Libby Creek Road (#2316), the Cable-Poorman Road (#6214) the Lower Fisher Creek Road (#6744), and the Midas Creek Road (#4778). (A separate portion of Road #4778 near Howard Creek was discussed in the DEIS as proposed for closure by the KNF.) If these roads would not provide adequate habitat mitigation, other roads that could be closed based on their priority for providing grizzly bear mitigation are—the Upper Bear Creek Road (#4784), the Upper West Fisher Road (#6746 and 6746C), the Bramlett Creek Road (#2332), the Lake Creek Road (#6748), the Upper Miller Creek Road (#4724), and the Lower Granite Road (#4791).

Habitat protection would occur early in the project life. Noranda has proposed that all mitigation would be in effect within six years of project initiation.

Mortality control. Noranda would fund the salary of one full-time enforcement officer through the Montana Department of Fish, Wildlife and Parks (or equivalent funding agreed to by the Management Committee) throughout the project life. Additionally, Noranda would fund the salary of one full-time local information and education person through the first five years of the project. After the first five years, equivalent funding would be provided by Noranda for the same position or other activities approved by the Management Committee. Noranda would also support evaluation of effects on the grizzly bear population of selective hunting season restrictions in areas of high grizzly bear use.

Plan management. Noranda would work closely with a Management Committee responsible for administering the mitigation program. Noranda has proposed the committee consist of supervisory personnel from the U.S. Fish and Wildlife Service, the Montana Department of Fish, Wildlife and Parks, the KNF, and Noranda. The committee would approve all specific habitat acquisition, enhancement, replacement or protection proposed by Noranda prior to implementation. Noranda would prepare yearly progress reports on the plan's implementation. Noranda would provide a letter of credit, trust fund, bond or similar financial instrument to guarantee periodic payments as necessary to ensure plan implementation.

Northern Beechfern Mitigation Plan

The proposed project would result in a loss of a large population of northern beechfern, a USFS-designated sensitive plant species (see Chapter 4). Noranda has proposed a plan to mitigate the impact to this plant by salvaging and transplanting individual ferns from the project area to other similar habitats, primarily suitable sites along Bear Creek, Libby Creek, and Big Cherry Creek. Northern beechfern grows in moist, acid conditions under full shade. Initial field surveys for suitable transplant areas were conducted during the 1991 summer field session.

Noranda has proposed further studies by various specialists to propagate plants both vegetatively and from the gemination of spores. In addition, a limited transplantation trial was conducted at a selected site along Bear Creek with about five to ten palnts. According to Joe Elliott, the trial did not succeed. The plants had died as of the 1992 field season (Joe Elliott, pers. comm. w/ D. Leavell, KNF Botanist). Noranda also proposes to take five to ten plants to a

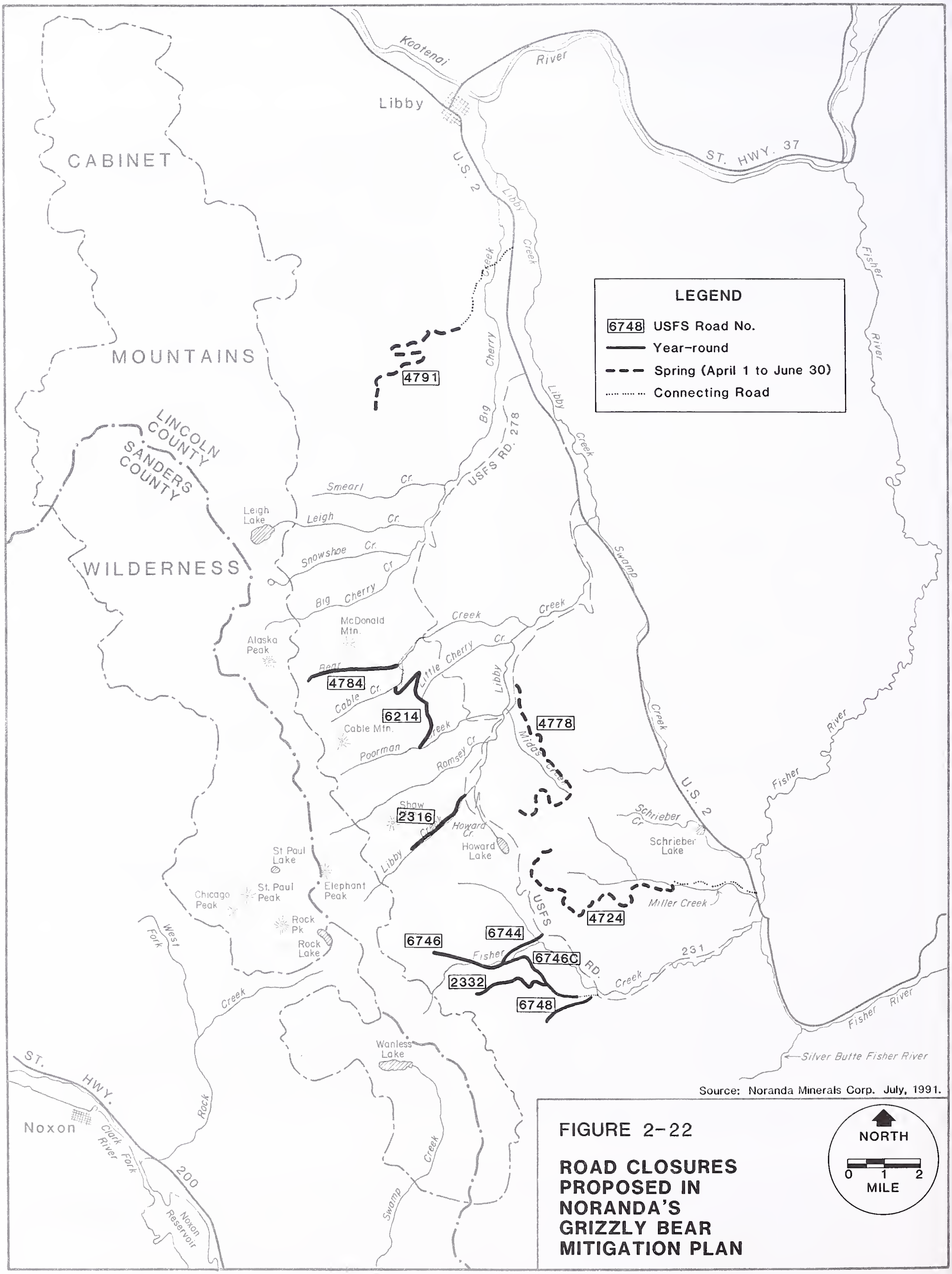


FIGURE 2-22

ROAD CLOSURES PROPOSED IN NORANDA'S GRIZZLY BEAR MITIGATION PLAN

greenhouse for a cultivation trial under more controlled environmental conditions.

If methods to cultivate or propagate this species are successful, Noranda would establish three to five transplanting sites in the vicinity of the mine area. Each site would be planted with ten to twenty-five individual ferns. Source stock probably would include plants salvaged from the existing population prior to clearing and topsoil stripping. Noranda would monitor these new populations for three years to determine success rates and to evaluate habitat suitability.

ALTERNATIVE 2—NORANDA'S MINE PROPOSAL WITH MODIFICATIONS

Modifications proposed by the agencies to Noranda's mine proposal include mitigating measures designed to reduce or eliminate identified environmental impacts. These mitigating measures are in addition to or instead of those proposed by Noranda. The amount of operational and post-operational monitoring would be increased. These modifications have been developed in response to the significant issues identified by the public and the agencies during the scoping process. The following sections describe the identified significant issues and the proposed modifications. All other aspects of Noranda's mine proposal would remain as described in Alternative 1. This alternative could be selected with any of the transmission line alternatives (Alternatives 4, 5 or 6).

Proposed Mitigation—Issue 1

Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear.

The agencies have developed several measures designed to reduce the effects of the proposed Montanore Project. These measures are designed not only to protect the current grizzly bear population and its habitat in the Cabinet Mountains, but to help meet the goal of recovery established in the KNF Forest Plan (Kootenai National Forest, 1987). Specifically, the mitigation plan is intended to reduce direct, indirect, and cumulative effects by providing for the spatial requirements of the bear, managing for an adequate distribution of bears, reducing mortality risks, and maintaining habitat suitability with respect to bear food production. The mitigation plan is presented in its entirety in the *Biological Assessment*, Appendix C. The mitigation plan is divided into five main parts—

- Mitigation plan management;
- Law enforcement and information/education programs;
- Habitat protection;
- Management of patented lands; and
- Additional measures.

The KNF is in formal consultation with the U.S. Fish and Wildlife Service regarding the proposed grizzly bear mitigation plan. The proposed mitigation plan and its effects could change based on the Fish and Wildlife Service's Biological Opinion.

Mitigation plan management. A Management Committee would be established to oversee implementation of the mitigation plan. The committee would consist of personnel from the U.S. Fish and Wildlife Service, the Montana Department of Fish, Wildlife, and Parks, and the Kootenai National Forest. Noranda would be represented on the committee but would not be a directing member.

The duties of the Management Committee would be—

- Prioritize and direct the land acquisition program;
- Evaluate proposals and approve specific habitat enhancement projects for acquired lands;
- Review progress reports on the status of the mitigation program;
- Determine effectiveness of the West Fisher road closures;
- Direct the activities of the Information and Education program;

- Evaluate the need for the I&E position after five years, and determine if the funds should be directed toward monitoring, research, or habitat management. Direct these activities if they occur; and
- Evaluate the effectiveness of reclamation and determine when roads closed as part of mitigation can be reopened, and the specific timing for releasing acquired lands.

The Committee would be responsible for land acquisition functions. The Committee would develop a list of desirable lands to acquire, and would prioritize these lands in order of importance taking into account the number of habitat units per acre available for each parcel, the location relative to the project area, and other related factors. Noranda would be responsible for carrying out the acquisition program, either directly or through contract with a third party. The Committee would be responsible for review and approval of each acquisition prior to purchase, and approval of conservation easements.

Law enforcement and information/education programs. Two new full-time wildlife positions would be created, with duties aimed directly at minimizing effects on grizzly bears. This includes a law enforcement officer and an information and education specialist. Noranda would fund each of the positions on an annual basis. The estimated total cost for the positions is approximately $2.9 million over the life of the project, assuming an initial annual cost of $96,000 per year and an average inflation rate of 4.2% per year (approximately $1.9 million in today's dollars).

The law enforcement position would be—

- an employee of the Montana Department of Fish, Wildlife, and Parks;
- funded through the end of the operating period;
- assigned to a specific area generally encompassing the southern portion of the Cabinet Mountains, particularly the East Front. A position description is included as Exhibit 1 in the *Biological Assessment* (Appendix C).

The information and education position—

- Would be an employee of either the U.S. Fish and Wildlife Service, Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, or Noranda, as determined by the Management Committee;
- Would include presenting grizzly bear conservation programs to mine employees, civic groups, and schools; making field contacts with recreational users and other Forest users who recreate in bear habitat; conducting compliance checks dealing with permit stipulations and road management; cooperating with Federal and State agencies and/or private landowners involved with grizzly management; preparing progress reports on the status of the mitigation program; and conducting reconnaissance of acquired lands and providing recommendations for habitat management. A position description is provided in Exhibit 2 in the *Biological Assessment* (Appendix C).

As discussed, the Management Committee would decide if the Information and Education position should be continued after the first five years of the project, or whether the funds should be used instead for programs such as grizzly bear monitoring, research, or habitat management. If the position is terminated at year 10, approximately $500,000 (today's dollars) would be available over the remaining life of the project for the above mentioned purposes.

In the future, if additional mines are developed in the Cabinet Ecosystem, funding for both positions may be shared by other mining companies, subject to approval by the Management Committee.

Habitat protection. There are three sub-parts to this mitigation measure; habitat acquisition, road management, and management of patented mining claims and mill sites.

Road management mitigations include both yearlong and seasonal closures. These closures are intended to off-set immediate effects of the mine operation by providing additional security adjacent to the impacted area, and replacing lost space and habitat units. The Forest Service would close six road segments in addition to those required to meet Forest Plan

standards, along with extending the closure on the upper Bear Creek Road #4784 from Sept. 1 to June 30 (current motorized closure on this road is from Oct. 15 to June 30).

The upper 6.4 miles of the West Fisher Road system would be closed yearlong by closure of three road segments (No. 6746, No. 6744, and No. 6746 C) (Figure 2-23). These road closures would be in effect prior to beginning construction activities, and continue through the operating period and into the reclamation period. The Management Committee would evaluate the effectiveness of these road closures and, if determined to be ineffective, replace them with a yearlong closure of the Bear Creek Road #4784.

Three road segments would be closed on a seasonal basis (April 1 to June 30). These include the South Fork Miller Road (No. 4724), the Midas Creek Road (No. 4778), and the Deep Creek Road (No. 4791) (Figure 2-23). These road closures would remain in effect throughout the project life and into the reclamation period. Proposed closures would be—

- The South Fork Miller Creek Road No. 4724 (6.6 miles) would be closed at the junction of the main Miller Creek Road No. 385;
- A "tie-through" road connecting Road No. 4724 with Road 4780;
- The Midas Creek Road No. 4778 (6.6 miles) would be closed at the junction of the main Libby Creek Road No. 231;
- The Deep Creek Road No. 4791 (5.2 miles) would be closed at the junction with Road No. 4792.

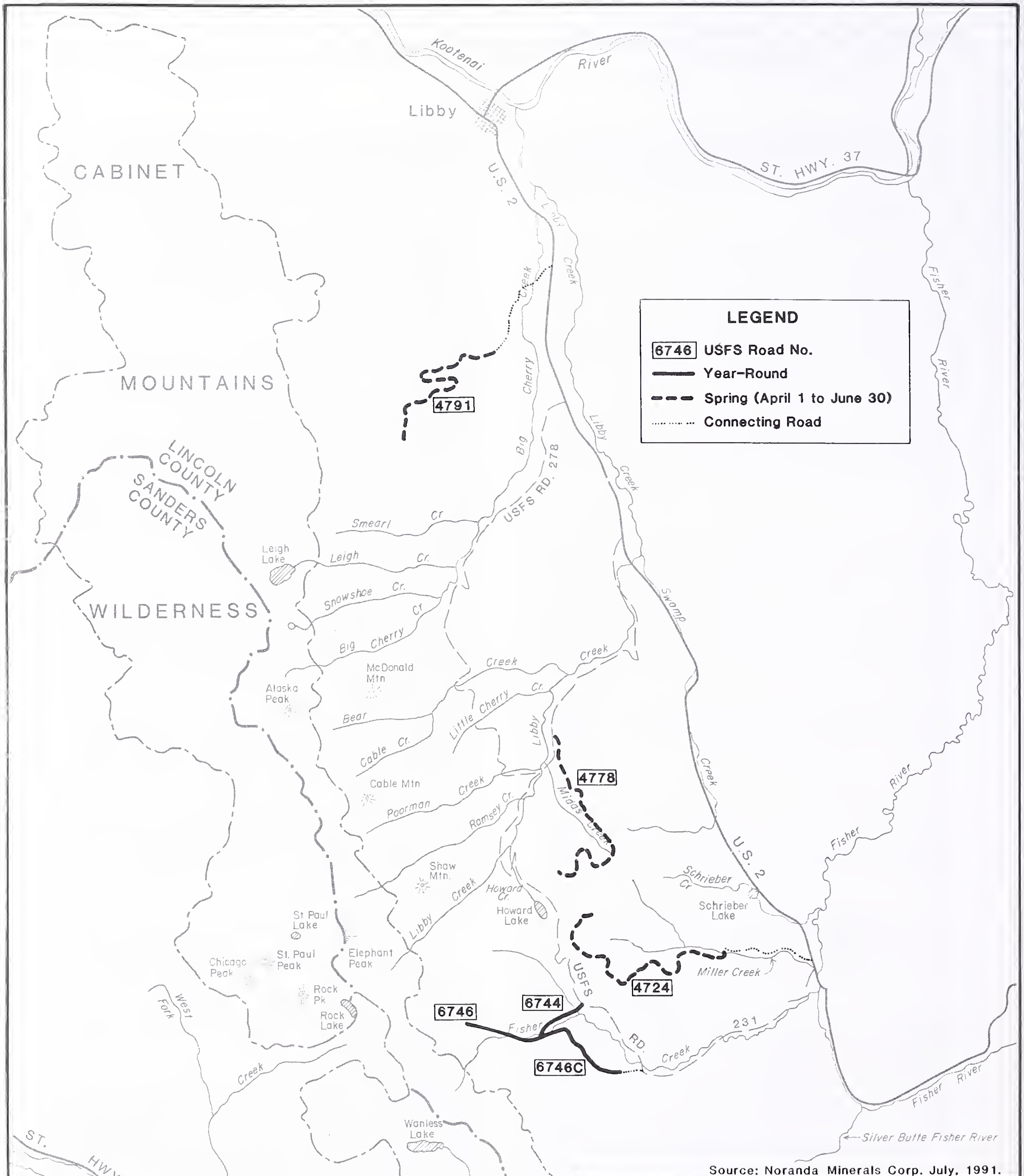
Noranda would purchase private lands or purchase conservation easements on private lands. The purpose of this mitigation is to replace space and bear habitat affected by the operation by protecting private lands that otherwise could be developed for other purposes. Approximately 537 habitat units would be purchased under this acquisition program. This is the amount of habitat units affected by the operation that are not replaced through road closures. Acquisitions would be completed within a six year period, beginning at the time of construction, with at least 50 percent completed within the first three years. Acquired lands would be managed for the best interest of the grizzly bears throughout the life of the impacts. All management would be approved by the Management Committee. Selection and approval of parcels to be acquired would be directed by the Management Committee.

The location of acquired lands would be within the Cabinet portion of the Cabinet-Yaak Ecosystem. Preference should be given by the Management Committee for lands within the affected Bear Management Units and lands along the east side of the Cabinet Mountains. Because of the potentially limited amount of lands that may be available for acquisition within this area, and for biological reasons, lands within other portions of the Cabinet Mountains might also be considered.

The acquisition plan provides the Management Committee with options for meeting the objectives. Per agreement between the Management Committee and Noranda, any of the following could occur with the acquired parcels:

- Noranda could purchase the private parcels directly, and then transfer title to the KNF, or other state or federal resource management agencies;
- Noranda could purchase the private parcels directly, and then transfer title to a private conservation organization, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears;
- Noranda could purchase private lands directly, and then retain title to the lands, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears; or
- in some instances, Noranda could purchase a conservation easement with fee title remaining with the private party.

Conservation easements generally would be established in perpetuity. The Management Committee could, on a case-by-case basis, accept conservation easements established for a fixed period



Source: Noranda Minerals Corp. July, 1991.

FIGURE 2-23.

ROAD CLOSURES PROPOSED IN THE AGENCIES' GRIZZLY BEAR MITIGATION PLAN

of time extending throughout the life of the impacts (not in perpetuity). If this option is selected:

- For those parcels acquired to compensate for habitat influenced but not physically altered by project activities, conservation easements would remain in effect, at a minimum, until the activities in the upper Ramsey Creek basin have ceased, and the road system returns to its current yearlong closure status;
- For those parcels acquired to compensate for physically altered habitat, easements would remain in effect until, at a minimum, the disturbed areas have been adequately revegetated. For those sites where revegetation with grizzly bear foods is desired, adequate reclamation would be completed when grizzly bear foods attain 40% coverage on one-tenth acre vegetative plots randomly selected in the affected area. This procedure is described in detail by Madel (1982), and was used as the basis for mapping high value foraging components in the Cabinet Mountains.

Noranda would provide the Forest Service "first-right-of-offer" before offering fee title of acquired lands to third parties. The Forest Service would seek a mineral withdrawal on any acquired lands to prevent future mineral entry. Under certain conditions, Noranda might also be able to enter into a land exchange with the Forest Service, and in return receive lands outside grizzly bear habitat.

After the Management Committee determines that project impacts have ended, the acquired lands could be used by others seeking mitigation for effects on grizzly bears, providing that acceptable conservation easements or other conditions are satisfied to protect these lands for grizzly bear use.

The direct cost for habitat acquisition is estimated at approximately $4.2 million. This is based on an estimated average of 3.9 acres per habitat unit at an estimated cost of $2,000 per acre. The actual cost for these lands would vary based on factors such as parcel size, location, owner, time of purchase, and whether a conservation easement was included with the property.

Noranda would guarantee funding for the acquisition program through payment of a performance or reclamation bond. The performance bond would either be separate from or included as part of the standard reclamation bond posted for the project. The bond would be posted prior to construction activities.

Management of patented lands. Any mill sites that Noranda might patent as a result of the Montanore Project, or mining claims that may be patented on the mineral deposit, would be managed to provide for grizzly bear use subsequent to the mining operation. This is to ensure that these lands are not developed after the mining operations for uses that could be detrimental to grizzly bears. Patented claims would be handled in one of three ways—

- As agreed to between Noranda and the Forest Service, Noranda would transfer fee title to the Forest Service once reclamation of the lands has been completed;
- Noranda would retain title to the lands, but would provide a permanent conservation easement directed at protecting the land for use by grizzly bears. The Management Committee must approve the provisions of the easement; and
- Noranda could sell the lands to another party providing that a permanent conservation easement is included. The Management Committee must approve the provisions of the easement.

Additional measures. Additional measures would be implemented to reduce mortality risk directly associated with the project. These measure also would reduce the project effects on other wildlife.

- The Forest Service would restrict public motorized travel in the upper Ramsey Creek drainage. This restriction will occur at the northeast corner of Sec.2 (T27N,R31W), at the junction of Road #6210.
- The Forest Service would set speed limits along access roads to minimize the amount of road kill that could in turn attract bears.
- Noranda would remove road kill from roads on a daily basis to reduce the potential for human-bear interaction.

- Noranda would prohibit employees from carrying firearms within the permit area, except for security officers and other designated personnel.
- Noranda would use bear proof containers for garbage.
- Noranda would prohibit employees from feeding bears.
- The KNF would close Big Hoodoo Mtn. Road (#6747) to all motorized traffic during the winter season (December 1 to April 30). This measure would reduce the expected displacement of moose in the tailings impoundment area.

Proposed Mitigation—Issue 2

Issue—Changes in the type, quality and displacement of general forest recreational activity and on the area's aesthetic qualities.

Noranda would develop a transportation plan for the agencies' review and approval during final design. The plan would discuss both the construction and operation phases. The goals of the plan would be to reduce vehicular traffic associated with the project and to minimize the size of parking area at the plant site. Busing and car-pooling are two options that should be considered in developing the plan.

Noranda would restrict ore concentrate trucks from the access road during shift change periods when a large number of employees would be traveling the access road. This measure would reduce traffic congestion and increase road safety.

Noranda would return the Bear Creek Road from the Bear Creek bridge to U.S. 2 to its pre-mine width unless the KNF would want a wider road. This measure would reduce post-mining road maintenance costs. The wider road would not be needed for the expected post-mining traffic levels.

If the Bear Creek and Libby Creek roads are snowplowed in the winter, Noranda would snowplow turnouts. Turnouts would provide increased safety, access and recreational opportunity.

The agencies would monitor use at the Libby Creek Recreation Gold Panning Area. If actual use increases significantly, Noranda would install three additional fire pits; construct a total of 1/2 mile of new walking access in several locations; and install a precast concrete vault toilet. These measures would reduce the impacts of the anticipated increased use of the area. Regardless of possible increases in use, 130 acres in the Gold Panning area would be changed from KNF Management Area (MA) 14 to MA 6.

Waste rock stockpiles and land application disposal areas would be designed to minimize impacts to visual resources. Proposed waste rock stockpiles would be no higher than 15 feet below height of tree canopy.

Noranda would develop three additional viewpoints, consistent with the Forest Plan, along the Bear Creek or Libby Creek roads focusing on the Cabinet Mountains. Noranda would undertake a roadside tree management program with the goal of obscuring views of the tailings impoundment from Libby Creek Road. These measures would mitigate the effects of the tailings impoundment on key viewpoints on the Libby Creek road.

Noranda would institute the air quality monitoring program described in Appendix B. The monitoring information would be used to verify compliance with the applicable ambient air quality standards. It would also be used in conjunction with visual observation of the operation by the agencies to evaluate the effectiveness of the proposed emission control measures and determine the need for any additional control measures as described in Chapter 4.

Proposed Mitigation—Issue 3

Issue—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation.

Earth-tone paints would be used at project facilities. This measure would reduce the visual contrast of the

facilities as viewed from the Cabinet Mountains Wilderness with the surrounding vegetation.

Noranda would ensure all equipment has properly maintained mufflers and other noise control equipment. Noise levels associated with equipment would be less than the EPA standard. This measure would ensure acceptable noise levels at the project facilities and along the access road.

Where possible, backup beepers would be replaced with the strobe light-type warning devices and the sound level of the backup beepers would be reduced to less than the normal 110 dB(A) at 10 feet. Regulations stipulate that the sound level of backup beepers must be audible in affected work areas. Sound levels of 90 to 100 dB(A) at 10 feet would provide audible warning at distances up to 50 feet behind a large front end loader.

Proposed Mitigation—Issue 4

Issue—Socioeconomic changes, including employment, income, community services, population, and public finance.

Noranda would develop written policies concerning local hiring and develop a worker training program. These policies and training program would seek to maximize local hiring, with the goal of obtaining at least 80 percent local hiring rate for operations workers, and 50 percent local hiring rate for construction workers. Local hiring would ensure a minimal number of new people moving to the area.

Proposed Mitigation—Issue 5

Issue—Concerns about the location and stability of the tailings impoundment.

The KNF would amend the Forest Plan (Kootenai National Forest, 1987) for the proposed tailings impoundment area. The new management area, affecting the area surrounding the tailings impoundment (about 1,000 acres), would be MA 31–Mineral Development. Management Areas are discussed in more detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of MA 31 are described in Appendix E.

Noranda would institute the tailings dam monitoring program described in Appendix B. This program is designed to ensure the stability of the tailings dam throughout the life of the project.

Before final design, Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. This additional monitoring and investigation would provide more detailed information on artesian pressures within the embankment area.

Noranda would continue to fund broad-scale inventories for northern beechfern on the KNF, to assess its status more accurately. The inventories would continue until the KNF deems the inventories sufficient. The KNF would develop a conservation strategy based on the accumulated field survey information. As part of this conservation strategy, the KNF would provide permanent protection for other known beechfern populations on the Forest. The number of populations protected would be determined in the conservation stategy. Although some transplanting could be conducted as part of an experimental program, transplanting would not be included as mitigation or compensation for the project.

Proposed Mitigation—Issue 6

Issue 6—Changes in quantity and quality of water resources and effects on aquatic life.

The agencies have developed several mitigations designed to reduce the changes in water quality and to improve the agencies' ability to detect changes in water quality and aquatic life. Gravels drains, discussed in the next section, are an example of an impoundment design change that would reduce tailings seepage into the underlying ground water.

The agencies also have modified the hydrology and aquatic life monitoring programs; these proposed modifications are discussed following the gravel drains discussion. The agencies' proposed monitoring plans are presented in Appendix B. If the monitoring indicates that Noranda's disposal of excess water has exceeded water quality standards, or affected beneficial uses, Noranda would have to implement corrective actions. Appropriate corrective actions would include changes in proposed operating plan which would result in compliance with applicable regulations. Water treatment is an example of corrective action that could be implemented.

Gravel drains. A pressure relief/seepage collection well system has been proposed by Noranda. The system includes up to 110 wells near the toe of the impoundment dam. Because of the perceived uncertainties of the proposed well system in collecting tailings seepage, the agencies developed an alternative system to minimize the quantity of seepage entering ground water.

The alternative seepage collection system—gravel impoundment drains—has been developed by the agencies for purposes of discussion and comparison. Design changes other than gravel drains may accomplish the same objective and would be considered by the agencies during final design review.

Systems similar to gravel drains have been employed extensively in tailings dams for both stability and seepage control reasons (Stine et al., 1986; Dorey and Byrne, 1982; Caldwell et al., 1983). Large drains have been extensively employed in the mining industry beneath high waste rock dumps (Brawner, 1986). Drains are multipurpose elements and function both to promote dam stability and minimize seepage and changes in water quality. Long experience with flow through rockfill dams demonstrates the capacity of coarse rock to transmit large volumes of water (Leps, 1973). Filter criteria for design of drains have been applied for about 50 years as a matter of standard engineering practice (Cedergren, 1977).

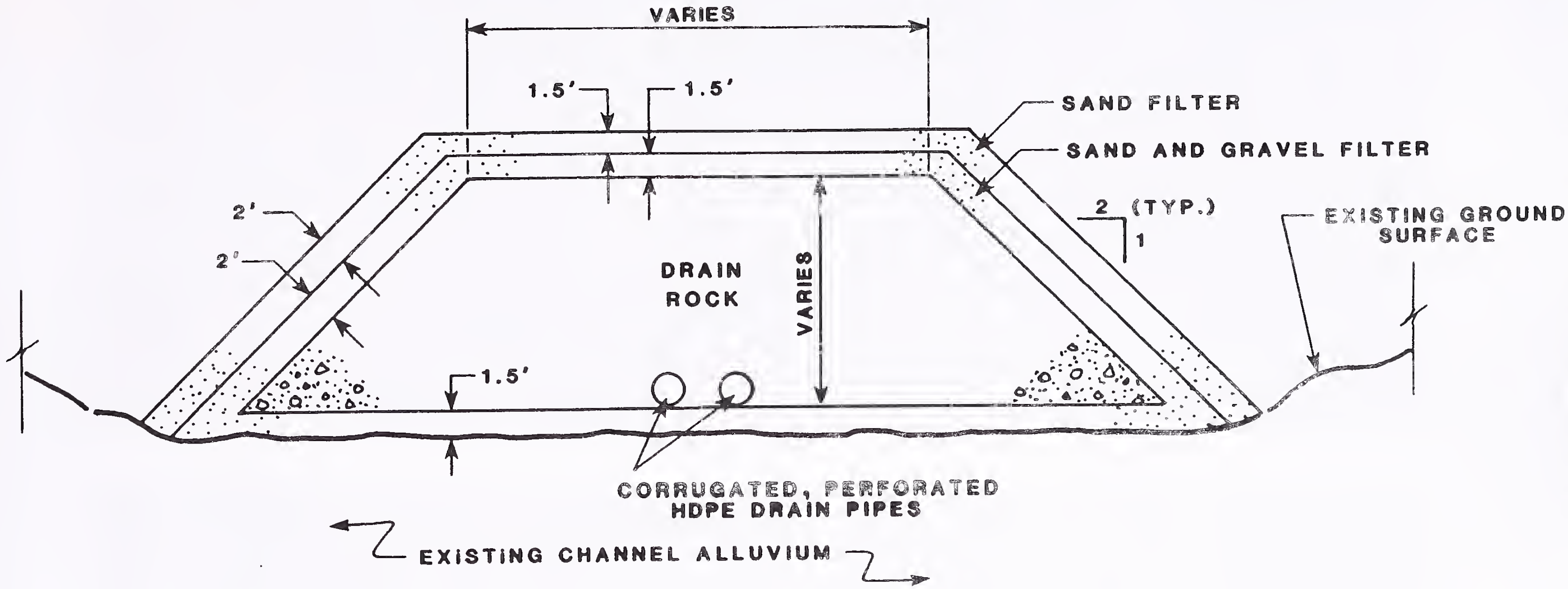
The proposed extensive underdrain system to reduce hydrostatic heads (pressure from the water stored within the tailings impoundment) would consist of high capacity granular drains in the main drainages interconnected with granular crossdrains or corrugated perforated high-density polyethylene (HDPE) pipe wrapped in a filter fabric. This drain system could be connected to the currently proposed blanket drain system beneath the dam, ultimately leading to the seepage collection pond. Synthetic lining of the bottoms of the main underdrains where higher static heads exist could also be included and would minimize seepage from the drains.

Because of the sloped impoundment surfaces, and with the presence of granular crossdrains or small diameter HDPE drain pipe, the tailings water would flow to the main drains and would be rapidly removed by these high capacity drainage elements, thereby maintaining low hydraulic heads. The synthetic lining, if included, would minimize seepage exiting the main drain, within which small hydraulic heads would be continuously present.

A typical suggested cross section of a drain beneath the starter dam and within the impoundment is illustrated in Figure 2-24. The main drain segment beneath the dam could be lined with a synthetic liner, such as high density polyethylene.

Drain rock and sand and gravel filter material could be produced by crushing harder rock from mine waste. The exact gradation of these materials and geometry of the drains could be established by an experimental crushing program, permeability testing and standard filter analysis (Cedergren, 1977) during design. Screening and blending operations may be necessary to produce the filter material.

To avoid plugging of the drain rock with tailings, the drain rock would be entirely encapsulated in filter material (Figure 2-24). The filter material would consist of a two stage filter of sand, and sand and



NOTE: Dimensions are for illustrative purposes only.
The actual dimensions would be developed during final design.

FIGURE 2-24

TYPICAL DRAIN SYSTEM CROSS SECTION

gravel. This material could be obtained from surficial site soils or produced from processed mine waste rock. Filtration could also be achieved by a filter fabric protected with coarse tailings sands in lieu of sand and gravel. The materials utilized should be relatively clean and their grain size distribution should be compatible with both the underlying drain rock and the overlying tailings.

Construction of the drains would progress ahead (upstream) of the impounded tailings as the impoundment fills. Tailings would be placed selectively to cover the drains to minimize inflow as the decant pond advances upstream over the drains. The purpose of this tailings cover would be to prevent excessive flow from the decant pond to the downstream collection pond, permitting maintenance of a decant pond. Placement of such a tailings cover over drains is routinely performed as part of the operation of many tailings disposal facilities, and is not a major operational difficulty.

Placement of the tailings sand cover above the drain rock would also increase the surface area and the effectiveness of the granular drains. As finer tailings slimes settle and consolidate over the drains, the effectiveness of the drains would be reduced as the low permeability slimes reduce the flow entering the drains. Plugging of the drain rock by tailings could also occur in the event of damage to the overlying filters (sand and gravel or cycloned tailings sand and filter fabric). Such drains, however, are typically very conservatively designed, with flow capacities at least ten times the anticipated working flow rate, to guard against the potential for plugging. A good level of quality control would be required during construction of such drains to assure that filter and drain materials are of sufficient quality and are properly placed; the very conservative nature of the drain design also helps guard against detrimental effects of potential variation in materials quality and construction procedures.

As a second element of the drainage system, 3 or 4-inch diameter, corrugated and perforated, HDPE pipe wrapped with filter fabric or granular crossdrains could be placed throughout the impoundment. To prevent disruption of the pipes as tailings are placed, the pipes would be placed sequentially just above the tailings surface along topographic contours. The ends of the drain pipe would be terminated in the drain filter zones with caps being placed on the ends. In the event of collapse and intrusion of tailings into the pipes, this would prevent the tailings from entering and clogging the drain rock.

The underdrain system covered by a layer of slimes of relatively low permeability also would reduce heads beneath the decant pond. The reduction and the small size of the pond would serve to minimize the amount of seepage. Estimated construction costs of the drain system, ranging between $1 and $2 million, would depend primarily on the availability of drain rock and filter materials, and the degree of processing necessary for production of these materials.

The amount of seepage collected by the drain system would depend on the actual design of the drains. Without additional analysis and design, the effect of installing gravel drains on seepage volumes and the pressure relief/seepage interception system can not be quantified precisely. If 60 to 70 percent of the 475 gpm of seepage is intercepted, a total of about 300 gpm would be collected and 175 gpm would enter the underlying ground water. Noranda estimates that their pressure relief/seepage collection well system would intercept 80 percent of the tailings impoundment seepage in Year 16. Decreased seepage from the described gravel drain system might reduce the effectiveness of the interception system and 80 percent of the seepage may not be intercepted. Based on this estimate, about 140 gpm of seepage would be collected by Noranda's seepage interception system in Year 16 of operations. Therefore, the remaining tailings seepage that would enter the ground water system underlying the impoundment and ultimately discharge to Libby Creek is estimated to be about 35 gpm in Year 16. All collected seepage would be pumped back to the tailings impoundment. Reducing seepage would affect the operating water balance.

As part of final design of the system, Noranda would submit a revised water balance.

Monitoring plan modifications. In addition to the operational monitoring analytical list (see Appendix B), Noranda would analyze adit and mine water for barium, thallium, beryllium, nickel, selenium, and antimony during the initial construction year. During the first year of operations, Noranda would analyze tailings pond water for the same metals. If these discharge waters have concentrations of these metals that could have an environmental effect, the metals would be added to the operational monitoring analytical list shown in Table B-2 in Appendix B.

Noranda would monitor fish populations at three-year intervals in a single appropriate stream reach, located just upstream from Station L1. Sampling procedures would include single-pass electro-shocking and recapture to collect trout from a 300-yard reach of stream. Population densities of each fish species captured during the study would be estimated, where adequate sample sizes permit, using an appropriate small-sample, capture, marking, and recapture population estimation procedure (e.g., the Seber-Lecren multiple pass method). All captured fish would be examined for overt signs of disease and parasites.

Noranda would conduct routine laboratory toxicity testing to monitor the potential acute toxicity present in mine and adit water that would be discharged to the land application disposal area, and decant waters from the tailings pond. For pre- and post-operational monitoring, waters for toxicity testing would be collected from Libby Creek (Station L1) during aquatic monitoring in August. This testing and the reasons for testing are fully described in Appendix B.

Cadmium would be analyzed along with mercury and lead in fish tissues as part of the aquatic life monitoring program.

As part of the final mine design, Noranda would develop a representative underground sampling and acid-base testing program on rock from the adits, ore zones, above and below the ore zones, and in the barren zone. These samples would supplement those already collected from the Libby Creek adit and drill core. Sampling and testing also would be conducted on the tailings. Kinetic geochemical testing would be done on representative samples of all affected rocks and for the tailings. Noranda would provide the agencies with maps prior to mine closure characterizing sulfide concentrations along the adit walls and mine exposures. This information would be used along with water monitoring data to predict post-mining water quality and design measures deemed necessary to protect water quality following cessation of operations.

Kinetic test results of adit and mine waste rock proposed for use in plant site or tailings impoundment construction would be provided to the agencies prior to the rock being used for construction purposes. This material would not be used for construction purposes if it is shown to be acid generating. Acid generating rock would be segregated for special handling. These measures would help ensure that acid generating material is not used for construction purposes.

Other modifications. Noranda would collect additional information prior to final design of the pressure relief well system. Before final design, Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a redundant ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigations would provide more detailed information on artesian pressures within the embankment area.

If a temporary structure is used at Ramsey Creek to provide access during adit construction, Noranda would size the structure to convey, at a minimum, the 50-year flow event.

Noranda would not withdraw any surface water for operational use during average annual low flow periods. In lieu of measured low flows, calculated

low flow using data from similar drainages would be acceptable.

Noranda would design a channel that provides adequate erosion protection from the outlet of the Little Cherry Creek diversion channel to Libby Creek. The design of the channel would be approved by the agencies prior to construction. The channel would reduce erosion along the hillslope at the outlet of the diversion channel and consequent transport of excess sediment into Libby Creek.

Noranda would design a riprapped channel to transport runoff from the reclaimed tailings impoundment surface to Bear Creek. The design of the channel would be approved by the agencies prior to construction. The channel would reduce erosion along the hillslope and consequent transport of excess sediment into Bear Creek.

Noranda would provide wetlands replacement acreage on a 2:1 basis for the existing forested and herbaceous wetlands that would be affected by the project. The 5.9 acres of the waters of the U.S. would be replaced on a 1:1 basis. Additional mitigation is necessary for these three types of resources because of the uncertainty associated with replacing their function and values. Using wetlands to mitigate for water of the U.S. would be out-of-kind replacement. Herbaceous/ shrub wetlands would be replaced on a 1:1 basis, as proposed by Noranda.

Noranda would modify its monitoring plan to extend the time for monitoring newly created wetlands. Intensive monitoring would be conducted every year as proposed by Noranda through Year 5. Less intensive monitoring would be conducted every two years thereafter through the end of production. Monitoring methods would be those described for wetlands mitigation monitoring under Alternative 1. This monitoring would include a field review during late summer to ensure any constructed berms or channels were functioning properly, an evaluation of vegetation to determine the health of wetland plant communities, and general hydrologic observations. More intensive investigations would be conducted if problems are noted, and remedial actions taken, as appropriate, in consultation with the agencies. The biannual monitoring would be documented in a letter to the agencies. Noranda would develop a monitoring plan to determine any effects to existing wetlands downstream of the tailings impoundment. If the functions and values of downstream wetlands are adversely affected, Noranda, in cooperation with the agencies, would develop additional wetlands mitigation.

To mitigate the fisheries impacts associated with the Little Cherry Creek diversion, the agencies propose the following mitigation—

- Immediately prior to construction, the portion of the Little Cherry Creek affected by the diversion would be block netted, then one half of the enclosed fish collected by hand and moved to Midas Creek, which would be largely unaffected by the proposed mining, and an equivalent number of hybridized trout would be removed from Midas Creek. The other half of the captured trout would be restocked in the diversion channel as a reserve for future conservation work;
- Approximately 50 feet of outlet from Howard Lake would be improved using grade control structures, overhead cover, clean gravels, and proper flow/depth design to create new spawning and rearing habitat;
- Up to 500 feet each in the two tributary streams to Howard Lake would have their potential spawning habitat improved by removing obstructions and adding one hiding pool per 50 feet;
- To attempt to create natural stream spawning population of interior redband trout in Howard Lake, the State of Montana for three years would release a portion of any total juvenile trout stocked annually in Howard Lake into the improved tributaries;
- Enhance spawning fish migrations by modifying the Midas Creek culvert (under USFS Rd. 231) to allow upstream passage during spring spawning periods.
- Install ten logdrop-plunge pool structures (1 per 100 feet) in Midas Creek, with 3-log overhead cover, to improve hiding cover for spawning fish.

- Noranda would finance additional fish investigations to determine the genetics, distribution, and abundance of the Libby Creek watershed redband and bull trout. A subsequent interagency conservation strategy would identify what actions are needed in the Libby Creek watershed to upgrade this population to sensitive and secure status. Noranda would partially fund (50%) trout conservation activities in Libby Creek designed to result in a 98%-pure redband population in Libby Creek. These activities would require construction of a downstream barrier to inmigrating rainbows and cutthroats, removal of non-native trout or stocking with redbands, and periodic genetic sampling.

Mitigation would proceed with the supervision and assistance of the State of Montana and KNF fisheries biologists. All mitigation would occur on KNF lands.

Noranda would provide the agencies with an updated mine design within two years of operation (after mill operation). The agencies would have a mine engineer review the design and inform the agencies of any potential problems that could lead to subsidence. The purpose of this review would be to verify conclusions reached on the preliminary mine design. Although it is not the intent of the agencies to dictate design standards to Noranda, the agencies may request modification of the mine plan if significant problems are noted that could lead to surface subsidence and resultant effects on ground water hydrology.

ALTERNATIVE 3—NORANDA'S MINE PROPOSAL WITH MODIFICATIONS AND WITH WATER TREATMENT

Alternative 3 consists of Noranda's mine proposal described under Alternative 1, and the agencies' mitigation described under Alternative 2. This alternative would be selected with one of the transmission line alternatives 4, 5, or 6. In addition, the agencies have developed, for the purposes of comparison, several water management and water treatment options designed to minimize or eliminate the effects to surface and groundwater resources. To provide a full range of alternatives, the agencies have developed three options (Options A, B or C) of handling and treating tailings impoundment seepage and excess water disposal. The three options are—

- Option A–full lining of the impoundment and mechanical treatment of all excess water;
- Option B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Option C–alternative water management/land application treatment of all excess water.

Option A–Full Lining of the Impoundment/Mechanical Treatment of All Excess Water

Under Option A, Noranda would place a synthetic liner beneath the entire tailings impoundment and seepage collection pond. Full lining of these areas would reduce seepage into the underlying ground water to the lowest volume technically possible. Under Option A, Noranda would not install a system designed to intercept seepage prior to entering ground water, such as the gravel drains, described as a part of Alternative 2. Noranda would revise its water management plans completely to account for the lack of tailings impoundment seepage during and after operations. During and after operations, all excess mine, adit or tailings water would be treated with a mechanical treatment system described in a subsequent section. In addition, Option A includes the treatment of excess adit and mine water during the construction period. Impoundment lining and mechanical treatment are described more fully in the following sections.

Impoundment lining. Tailings impoundment seepage could be minimized by a synthetic liner (such as high density polyethylene) or a compacted clay liner over the entire impoundment area. Lining the impoundment would reduce tailings seepage substantially, and reduce the uncertainty associated with collecting tailings seepage using the pressure relief/seepage interception system, as discussed in Chapter 4. Full lining with synthetics or clay has been employed on several uranium and gold projects

(Lubina et al., 1979; Small et al., 1981; McCready, 1989), but has not been applied to any large-tonnage base metal projects. Lining of impoundments at uranium and gold operations is more routinely undertaken because of the deleterious nature of the tailings water quality.

Full lining with a synthetic liner or compacted clay would be feasible at the Little Cherry Creek site. The site has relatively gentle topography and little exposed bedrock within the impoundment area. The impoundment surfaces could be relatively easily prepared to receive synthetic lining, and the gentle slopes and generally granular surface soils would contribute to the stability of the liner on slopes. Placement of a compacted clay liner may not be practical, since there are no known deposits of suitable clay in the project area vicinity. Large bentonite clay sources exist in eastern Montana, but transportation costs to the project site could be prohibitive.

Potential leakage through a synthetic liner can be due to either permeation (water movement) through an intact liner or leakage through liner defects. Published results of theoretical liner permeation estimates for 80-mil thickness liners (EPA, 1987) indicate maximum steady state flows of about 0.2 gallon per acre per day, or about 92 gallons per day (0.06 gallon per minute) for the 460-acre final pond area at the Little Cherry Creek site.

Recent research (Brown et al., 1987; Giroud and Bonaparte, 1989a, 1989b; Giroud et al., 1989; EPA, 1987) indicates that with intensive quality assurance monitoring, defects in synthetic liners can be limited on the average to one "standard" defect measuring 1/16-inch square per acre of liner. Using this standard defect, for a 40-mil thick liner, the estimated leakage rate ranged from about 0.2 to 1.0 gallon per acre per day, depending on the degree of contact between the liner and the compacted subgrade (EPA, 1987). For a fully-lined Little Cherry Creek impoundment, a leakage rate from about 92 to 460 gallons per day (0.06 to 0.31 gallon per minute) is estimated.

As discussed in the previous *Water Use and Management* section, Noranda estimates that a maximum 475 gpm would seep from the impoundment into the underlying ground water. This seepage quantity is an estimate and may actually be less (Morrison-Knudsen Engineers, 1990c). Noranda further estimates that following installation of the pressure relief/seepage interception system, that seepage ultimately reaching Libby Creek would be about 100 gpm. Lining would reduce tailings seepage substantially and reduce the volume of tailings water reaching surface streams.

Lining the impoundment also would affect Noranda's proposed water management during operations. Impoundment lining would not affect the water balance during the three year construction period. Because makeup water would be required during the first seven years, excess tailings water would be used in the mill, reducing makeup water requirements during this period. No tailings water would require treatment during operations. Increased discharge of adit water would be required beginning in Year 8, in comparison to Year 10 under Alternative 1. Noranda estimates 183 gpm of excess water in Year 16; lining the impoundment would increase the amount of excess water to 268 gpm. Noranda estimates 542 gpm of total adit inflows in Year 16. Under this Option, the 268 gpm of excess water requiring disposal would be adit water and not tailings water. All tailings water could be used in the mill throughout operations. Adit water affected by blasting could be segregated from adit water unaffected, and mechanical treatment may not be necessary if adit water is equal to or better than ambient water. Excess tailings water would require disposal to a LAD area beginning in Year 17 for an estimated three-year period.

Mechanical water treatment systems. The agencies have identified three mechanical treatment systems which may be suitable for treatment of excess mine,

adit, or tailings water. The three systems are evaporator, reverse osmosis, and ion exchange. Typical removal efficiencies for the three treatment methods are shown in Table 2-13. Precise removal efficiencies would depend on the exact quality of water requiring treatment.

Treated water would be either discharged to a land application disposal area, or discharged directly to surface water. The method of disposal would depend on treated water quality. If treated water quality is equal to or better than ambient water quality at a point of discharge, the treated water could be discharged directly to surface water. A Montana Pollution Discharge Elimination System permit from the DHES would be required prior to any surface water discharge. If treated water quality is not equal to or better than ambient water quality (it might have slightly elevated nitrate or ammonia concentrations), the treated water would be discharged to a LAD area.

Metals concentrations in area streams and expected metals concentrations in tailings, adit and mine water are extremely low, some of them below the analytical detection limit. Consequently, the actual concentrations of some metals in area streams and the water that would be treated is unknown. All three treatment systems may require an authorization to change ambient water quality because concentrations of nitrate, ammonia or some metals in area streams following land application disposal may be above ambient concentrations.

The water treatment systems described in the following sections are based on available water quality data and conceptual design. Selecting a water treatment alternative would require additional feasibility analysis, design, and possibly testing. These systems have not been used to treat waste water from hard-rock mines or mills, and their applicability may need confirmation. Information on other constituents in the water that would require treatment, such as suspended solids and sulfates, would be needed prior to treatment system selection. Noranda would be responsible for developing final design of the water treatment system. The test results, if any, and final design would be submitted to the agencies for review and approval. Treatment methods other than those described are available.

Evaporator. Two types of evaporator systems are available. One system would consist of a vertical tube, falling film evaporator designed to treat wastewater contaminated with inorganic compounds. Treated water would be recovered from the waste stream reducing the final volume of discharged water

Table 2-13. Typical removal efficiencies for selected constituents.

Treatment system	Total dissolved solids	Heavy metals	Ammonia nitrogen†	Nitrate nitrogen
Forced Circulation Evaporator	<2 to 10 mg/L	>99%	0-90+%	>99%
Falling Film Evaporator	(similar removal efficiencies to forced circulation)			
Reverse osmosis				
"Brackish-type" membranes	~95%	~95-99%	70-90+%	~70-90+%¶
"Sea-water type" membranes	~99%	99+%	~96%	~97%
Ion exchange†	<5 mg/L	<1 mg/L	<1 mg/L	<1 mg/L

†The degree of removal would depend on specific operating conditions, particularly process pH. Supplemental treatment may be necessary to meet discharge criteria.
¶Nitrate/nitrite removal will vary with the type of membrane and specific operating conditions.

to about one percent of the original volume. The concentrated waste water would be collected in a small solar pond and evaporated or sent to a dryer and evaporated. A small quantity of metal salts would accumulate as a solid either in the pond or in the dryer. Under certain conditions, this system is susceptible to decreased efficiencies due to formation of salts or oxides. Increased operating costs would be incurred to maintain efficiency.

An alternative system that also would use evaporation is called a "forced circulation system." Because of the uncertainties associated with influent water chemistry and quantities, a forced circulation system may be preferred. A forced circulation system, however, has electrical requirements two to three times greater and considerably higher operating costs than a falling film system. Both systems have similar capabilities to remove nitrates, total dissolved solids, and metals. Wastes generated by the evaporator system may be hazardous. Additional water quality information would be needed prior to selecting the best evaporator system. System choice would depend on influent water chemistry and quantities, duration of treatment, financial considerations, and waste disposal options.

Reverse osmosis. Reverse osmosis treats water by forcing it through a semipermeable membrane. The membrane allows water molecules to pass through, but does not allow dissolved solids and metals to pass. Reverse osmosis requires a relatively particulate-free influent to prevent "clogging" of the membrane. Prior treatment of the influent water through conventional filtration or settling technology (such as that currently being used at the Libby Creek adit) could be used to remove suspended solids and prevent membrane clogging. Reverse osmosis is capable of reducing total dissolved solids (TDS) by over 90 percent, and metals by at least 95 percent (Colvin et al., 1983). Nitrates and ammonia would be only partially removed. These two constituents could be more effectively removed using more efficient "sea water" membranes (membranes used to treat sea water high in total dissolved solids) and chlorination for ammonia removal.

Between 12 and 25 percent of the influent water would be generated as a waste stream (brine) using reverse osmosis. Nearly 150,000 gallons per day would be produced using a reverse osmosis system treating 550 gpm. The waste water would have higher concentrations of metals, dissolved solids, and other compounds and would need treatment using an additional system, such as one of the evaporator systems previously discussed. Disposal options for the brine are limited. Camp, Dresser, and McKee, Inc. (1992) identified transportation to an off-site disposal facility or wastewater treatment facility as the most likely disposal option. Transportation costs would be considerable. In addition, the resultant generated waste solids would require disposal.

Routine maintenance would include instrument calibration, chemical cleaning and periodic membrane replacement. Membranes would require replacement every three to five years and disposal as solid waste.

Ion exchange. Ion exchange removes nitrates, dissolved solids and metals by treatment with synthetic ion exchange resins. Heavy metals also can be removed. Metallic ions such as sodium, potassium, calcium, magnesium and heavy metals are removed by a packed bed of cation exchange resin, and are replaced in solution by hydrogen ions. Similarly, negative ions such as chloride, sulfate, nitrate, and bicarbonate are removed by a packed bed of anion resin, and are replaced in solution by hydroxide ions. Equal numbers of hydrogen and hydroxide ions are produced, which then combine to form water. This process is referred to as "demineralization". A sodium-based cation exchange process is commonly used in water-softening demineralization systems. Reduction of TDS and metals is generally good using ion exchange. Removal efficiencies for particular metals and nitrates, however, would depend on overall water chemistry and would vary over time. Resins specifically designed for nitrate removal are

available. Since many of the estimated metals concentrations of discharged waters are below detection limits (see Chapter 6), exact removal efficiencies cannot be provided.

Ion exchange demineralization is typically used for waste streams with TDS concentrations of less than 750 mg/L. Although Noranda's discharges are estimated to have TDS concentrations less than 500 mg/L, recycling of the mill and tailings water might increase TDS concentrations. If sustained TDS concentrations greater than about 750 mg/L occur, an alternative treatment system should be considered.

Ion exchange demineralization, like reverse osmosis, would need a pre-treatment step to remove suspended solids. Conventional technology could be used. The specific choice of process would depend on the actual constituents requiring removal. An additional treatment process, such as one of the evaporation systems described, may be necessary to concentrate the high TDS wastewater further prior to salt disposal. Camp, Dresser, & McKee, Inc. (1992) suggested using a mobile ion exchange and regeneration unit. Trailer-mounted exchangers tanks and resin would be transported to the mill site. When exchangers are saturated, the tanks would be hauled to an off-site location for regeneration.

Costs. The agencies' conceptual costs for mechanical water treatment systems are shown in Table 2-14. The costs shown have been developed by the agencies and are for the treatment of 550 gpm. Costs shown also do not include any necessary pretreatment or secondary treatment. For example, a filter system may be necessary as a pretreatment step for the reverse osmosis or ion exchange systems. The specific choice of process would depend on the actual constituents requiring removal. Also, wastewater high in TDS from the reverse osmosis or ion exchange systems probably would require off-site disposal, or additional treatment with an evaporator or similar system and a means of suitable disposal for any generated salts. Costs associated with disposal of waste water or waste salts are not included in Table 2-14.

Noranda also has conducted preliminary investigations into the feasibility and costs of water treatment (Camp, Dresser, & McKee, Inc., 1992). Noranda evaluated the feasibility and costs of ion exchange and reverse osmosis, with an ion exchange system being recommended. Noranda estimates a full demineralization ion exchange system for 200 gpm would cost $1.2 million, with an additional $0.4 million for contingencies and engineering. Noranda's estimated capital and annual operating costs for treatment of varying volumes are shown in Table 2-15.

Table 2-14. The agencies' conceptual costs for mechanical water treatment systems.†

Water treatment system	Capital costs (total)	Capital cost per ton of mined ore*	Operations and maintenance costs: Annual	Operations and maintenance costs: per ton of mined ore*
Evaporator				
Forced circulation	$7.7 million	$0.08	$4.4 million	$0.04
Falling film	$7.6 million	$0.08	$1.5 million	$0.02
Reverse osmosis	$1.3 million	$0.01	$0.16 million	$0.002
Ion exchange	$0.9 million	$0.01	$0.21 million	$0.002

†The costs shown are for the primary treatment of a nominal 550 gpm and are exclusive of pretreatment, secondary treatment, or salt or brine management and disposal.
*Based on 95 million tons of ore.

Table 2-15. Noranda's estimates costs for demineralization ion exchange water treatment.

Treatment capacity	Capital costs	Annual operating costs
	(million $)	
200 gpm	1.66	0.63
400 gpm	2.49	1.08
600 gpm	2.98	1.50

Source: Camp, Dresser, & McKee, Inc., 1992

The cost of fully lining the tailings impoundment and seepage collection pond is estimated to be $26,000 per acre, or about $12 million for the final impoundment and $0.4 million for the seepage collection system. Treatment of 550 gpm of adit and mine water during the three-year construction phase would be about $7.5 million in capital and operation costs (using Noranda's preproduction estimate of cost of ion exchange treatment).

Under Option A, treatment of excess adit water may be required beginning in Year 8 (as compared to beginning in Year 10 under Alternative 1). Since adit water affected by blasting could be segregated and handled separately from adit water unaffected, treatment of excess water may not be necessary if adit water quality is equal to or better than ambient water. Samples of Libby adit inflows indicates that adit water quality could meet ambient water quality (see Table 6-10 in Chapter 6). Treatment of excess tailings water would be required for an estimated three-year period after operations. Treated water would be discharged during the growing season to a LAD area if concentrations of constituents in treated water are above ambient concentrations or directly to Libby Creek if concentrations of constituents in treated water are below ambient concentrations. A permit from the DHES would be required prior to any direct discharge of treated water.

Under Option A, additional capital cost would not be incurred with treating excess water during operations, since the treatment system would be installed during the construction phase. Estimated costs of treating all excess water (adit water from Year 8 to Year 16, and tailings water from Year 17 to Year 19) are estimated at $7.5 million in additional operating costs (12 years @ $0.63 million/yr). Treatment of all projected excess water throughout the project life, including full lining of the impoundment, would cost an estimated $27.5 million (using Noranda's estimates of ion exchange treatment).

Option B–Mechanical Treatment of Some Excess Water/Land Application Treatment of Remaining Excess Water

Noranda's proposed water use and management is discussed in the previous *Water Use and Management* section. Noranda estimates that 553 gpm of excess water would be disposed at the Ramsey Creek LAD in Year 3 of construction. Noranda anticipates that after completing the adits, adit water quality would return to near bedrock water quality (see Chapter 6 for expected water quality). Of the 553 gpm, Noranda estimates that 280 gpm of "post-construction adit water" would have low nitrate and ammonia concentrations (≤1 ppm), and the remaining 273 gpm of "construction adit water" would have elevated nitrate and ammonia concentrations. There is some uncertainty in the estimates of nitrate and ammonia concentrations of "construction adit water".

Option B consists of mechanical treatment of excess construction adit and mine water with elevated nitrate and ammonia concentrations, and land application treatment of the excess post-construction adit water. In Year 3, an estimated 273 gpm would be mechanically treated, and 280 gpm would be land applied at one or more of the land application disposal areas.

Also as a part of Option B, treatment of adit water beginning in Year 10 of operations, and treatment of tailings water in Year 17 would be required. The adit water would have post-construction adit water

quality and would be land applied at one of the land application disposal areas. Tailings water would have elevated concentrations of nitrate, ammonia and certain metals. This water (207 gpm in Year 17) would be mechanically treated with one of the systems described under Option A. Noranda anticipates discharge of excess tailings water would be required for a three-year period. As with Option A, treated water would be either discharged to a land application disposal area, or discharged directly to surface water, depending on treated water quality. This option may require an authorization to change ambient water quality because concentrations of nitrate, ammonia or some metals in area streams following land application disposal may be above ambient concentrations.

Under Option B, the tailings impoundment would not be lined, but a system designed to intercept seepage prior to entering ground water, such as gravel drains, would be installed. It is not known what the efficacy of the gravel drains would be (see discussion under Alternative 2). For purposes of costs, it is assumed that the gravel drains would not increase the amount of excess tailings water requiring treatment.

Costs. Estimated costs for treating 273 gpm of adit and mine water for three years during construction, and up to 210 gpm of tailings water for three years post-operations are $7 million in capital and operating costs. Cost for land application of "post-construction adit water" during construction and beginning in Year 10 of operations is not included in the estimate.

Option C–Alternative Water Management/Land Application Treatment of All Excess Water

Noranda would prepare a comprehensive water management/water treatment plan and submit the plan to the agencies during final design for review and approval. Water management would include storage of excess water during the winter months and the discharge of excess water to LAD areas during the growing season. A water storage facility, about 25 acres in size, would be constructed within the "footprint" of the tailings impoundment (see Figure 2-11). If construction of the Libby Creek adit began in the fall, Libby Creek adit water would be stored at the facility for disposal the following spring. If construction begins in the spring, water would be initially applied to a LAD area, and storage would begin in the fall. The storage facility would remain in place until construction of the tailings impoundment starter dam, expected to be completed during the second year of construction.

In addition to the Ramsey Creek LAD areas discussed under Alternative 1, land application of excess water also would occur in LAD areas constructed in the tailings impoundment area (called the Little Cherry Creek LAD areas). Water would be transported from the adits via a pipeline to the Ramsey Creek site no. 1. Water from site no. 1 would then be piped to Ramsey Creek site no. 2 or to the Little Cherry Creek LAD areas. Excess water would be land applied using conventional irrigation techniques. Potential Little Cherry Creek LAD areas include upstream of the impoundment, and downstream of the impoundment dam. Noranda has proposed using some areas upstream of the impoundment as borrow areas (see Figure 2-11). The areas would be reclaimed following removal of borrow material for the dam. After establishment of revegetation, reclaimed borrow areas could be used to a limited extent for land application of excess water. All proposed borrow areas probably would not be used for borrow purposes; areas not used for borrow could be used for land application.

About 450 acres of potential LAD areas exist downstream of the tailings dam. Noranda would use these areas during the construction and post-operations phases. For purposes of analysis, it was assumed that the Ramsey Creek LAD areas would be used to dispose of the post-construction adit water, expected to have low concentrations of ammonia and nitrate. The water with elevated ammonia and nitrate concentrations would be discharged to the Little

Cherry Creek LAD areas during the growing season (approximately May to October).

During operations, Noranda estimates excess water would require disposal beginning in Year 10. Adit water unaffected by blasting would be segregated and discharged to the Ramsey Creek LAD area. After operations, excess tailings water would be discharged seasonally to the Little Cherry Creek LAD areas. Discharge may occur for a five or six year period or more, depending on the overall water balance.

Option C would require more frequent monitoring of surface and ground water, and additional monitoring of adit and mine water quality. Surface and ground water stations potentially affected by discharges from LAD areas would be monitored monthly or twice-monthly during the first year of construction. Monitoring frequency after the first year would depend on the first year's monitoring results and would be decided by the agencies in cooperation with Noranda. Additional ground water monitoring wells hydrologically down-gradient of all LAD used for disposal would be needed in the Little Cherry Creek LAD area. Noranda also would sample adit and mine water with sufficient frequency to determine the average concentration and load of nitrates and ammonia contained in the discharged adit and mine waters (see Appendix B). The revised monitoring plan would be a part of the final design of the water management/water treatment plan submitted to the agencies for approval prior to construction.

ALTERNATIVE 4–NORANDA'S TRANSMISSION LINE PROPOSAL WITH MODIFICATIONS

This alternative includes modifications to Noranda's transmission line proposal. This alternative could be selected with either Alternative 2 or Alternative 3. Adjustments to the line as shown on Figure 2-1 would be made. In addition, a minor realignment of the line south of the Fisher River crossing would avoid an old landslide. The landslide would be crossed by a proposed access road, creating moderate to high potential for sediment to enter the Fisher River. A realignment of the line and access road 200-300 feet to the east and application of Best Management Practices would reduce potential for impact to low levels. Alternative 4 also includes construction and operation of the transmission line using methods described in Alternative 1 with the following modifications.

Noranda would use a helicopter rather than a crawler tractor during initial transmission line construction operations to string the ground wire and transmission line conductors. Conventional equipment and access roads would be used for other line construction operations. Using a helicopter also would eliminate the need to construct an access road down the center of the transmission line right-of-way and on sideslopes greater than 10 percent, which would be required if the stringing were done as proposed under Alternative 1. Decreased surface disturbance would reduce impacts to wildlife, visual, soils and vegetation resources.

The monopole steel towers used for the line would be treated or painted a darker non-reflective color. Non-reflective static wire and electrical conductors would be used for the entire length of the line. A non-ceramic insulator is recommended for the entire length of the line. If ceramic insulators are used, the color should be brown. Clear glass insulators would not be used. These measures would reduce contrast and visibility of the line from sensitive viewing locations.

The DNRC and the KNF have identified mitigation measures for use in sensitive areas crossed by the transmission line alternatives (Appendix H). The measures are designed to reduce or minimize identified visual, wildlife, soils, and hydrology impacts of the transmission line to those necessary in order to construct the project.

DNRC will ask the Board for the authority to work with Noranda to apply best management practices to match site-specific conditions based on this review.

This authority would include the identification of site-specific mitigation measures where required to ensure that the measures used at individual sites are the most appropriate for the situation.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 357 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 5–NORTH MILLER CREEK ALTERNATIVE TRANSMISSION LINE ROUTING

Alternative 5 would realign the transmission line route from the upper Miller Creek drainage to the mouth of Ramsey Creek (Figure 2-1). This alternative could be selected with either Alternative 2 or Alternative 3. Alternative 5 includes construction and operation of the transmission line using methods described in Alternative 1, except the modifications described in Alternative 4 would be incorporated. The impacts of Alternative 5 are compared with those of other transmission line routing alternatives in Chapter 4.

Alternative 5 would incorporate the mitigation measures identified in Appendix H addressing identified visual, wildlife, soils, and hydrology impacts. Proposed amendments by DNRC and the KNF to the environmental specifications discussed under Alternative 4 also would be recommended for approval by the Board.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 218 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 6–SWAMP CREEK ALTERNATIVE TRANSMISSION LINE ROUTING

Alternative 6 would realign the transmission line route from the Fisher River to the mouth of Ramsey Creek (Figure 2-1R). This alternative could be selected with either Alternative 2 or Alternative 3. Alternative 6 includes construction and operation of the transmission line using modified methods described in Alternative 4. Since no big game winter range would be crossed by this alternative, timing restrictions during the fall and winter would not be required. The impacts of Alternative 6 are compared with those of other transmission line routing alternatives in Chapter 4.

Alternative 6 would incorporate the mitigation measures identified in Appendix H addressing visual, wildlife, soil, and hydrology impacts. Proposed amendments by DNRC and the KNF to the environmental specifications discussed under Alternative 4 also would be recommended for approval by the Board.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 236 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 7—NO ACTION

Under this alternative, Noranda would not develop the Montanore Project. The environmental, social, and economic conditions described in Chapter 3 of this EIS would not be affected by the construction and operation of the Montanore Project. The Libby Creek adit site would be reclaimed in accordance with the exploration permit issued by the DSL.

ALTERNATIVES CONSIDERED BUT DISMISSED IN THIS EIS

The scoping process identified a number of alternatives determined by the agencies to be infeasible or otherwise unreasonable. The alternatives described in this section have been dismissed from further consideration. The reasons for dismissal are described in the following sections. The identification of these alternatives is the result of a sequence of alternatives analysis efforts, including the Kootenai National Forest's Mineral Activity Report (the MAC Report) on mineral activity in the Cabinet Mountains (Kootenai National Forest, 1986), analyses conducted by Noranda as part of the project planning process, and agency evaluation during the preparation of this EIS.

The dismissed alternatives fall into eight categories. The separation of alternatives is somewhat artificial, since many—even between categories—are interrelated. The categories are—

- tailings impoundment siting;
- tailings disposal techniques;
- tailings embankment construction methods;
- siting of other mine facilities;
- water treatment methods;
- power supply sources and transmission line routings;
- transmission line construction methods; and
- joint venture mineral development.

The following is a more detailed discussion of the dismissed alternatives.

Tailings Impoundment Siting

Tailings disposal at Little Cherry Creek would result in disposal of dredged or fill material into waters of the United States. Section 404 of the Clean Water Act requires a "404 permit" from the Corps of Engineers (Corps) before any dredged or fill activity affecting waters of the U.S. can occur. As part of its responsibilities under the Clean Water Act, the Environmental Protection Agency (EPA) may prohibit or restrict dredged or fill activities if the activity would adversely affect fish, wildlife, or recreation.

The Corps and the EPA have developed Guidelines to evaluate impacts from dredged or fill disposal activities on waters of the U.S. and to determine compliance with Section 404 of the Clean Water Act (33 Code of Federal Regulations, Part 320 and 40 Code of Federal Regulations, Part 230). "Waters of the United States" which include wetlands, are described in Chapter 3.

The 404 Guidelines require analysis of "practicable" alternatives that would not result in disposing dredged or fill material into waters of the U.S., or which would result in less environmental damage. Under the Guidelines, the term "practicable" means "available and capable of being done after taking into consideration cost, existing technology and logistics in light of overall project purposes."

Identification of alternatives. The primary objective of the MAC Report was to identify reasonable alternatives for locating various facilities associated with ASARCO's proposed Rock Creek project and other anticipated mining operations, including Noranda's. The MAC Report discusses alternatives for locating project facilities on the east and west sides of the Cabinet Mountains Wilderness. The report was based on general information available at the time. No subsurface site data was available, and the Montanore ore body was considered much smaller than current estimates indicates. A number of preferred alternatives were identified in the Rock Creek drainage. Alternatives in the Libby Creek drainage were considered less desirable from a resource management standpoint; recreation, wildlife and visual impacts were the primary concerns (Kootenai National Forest, 1986). The report recommended that alternatives in the Libby Creek drainage be considered in any future detailed evaluation.

Noranda considered 15 alternative tailings impoundment sites (Morrison-Knudsen Engineers,

Inc., 1988) and conducted preliminary geologic and geotechnical investigations on three sites (Morrison-Knudsen Engineers, Inc., 1989b). Development of a tailings impoundment and mill site in the Rock Creek drainage was considered. Possible impoundment sites on the Rock Creek side either lacked sufficient storage capacity, required excessive borrow amounts, or contained potentially unsuitable foundation soils. The sites chosen for more detailed investigations were Midas Creek, Poorman Creek, and Little Cherry Creek. The MAC Report also identified and evaluated impoundment sites in Little Cherry Creek and Midas Creek. Criteria used by Noranda for site selection included—

- sufficient tailings storage capacity;
- geotechnical characteristics, particularly consideration of subsurface seepage;
- watershed area and diversion requirements; and
- embankment volume.

The agencies independently reviewed tailings impoundment locations. Based on the 1988 investigation, all three sites had adequate storage capacity. More detailed mapping conducted as part of the 1989 study indicated the Poorman Creek site had inadequate storage capacity (about 70 million tons or a 9-year storage life). Construction of an additional impoundment would be required if the Poorman Creek site were used since Noranda anticipates producing about 90 to 100 million tons of tailings. The Little Cherry Creek and Midas Creek sites have a storage capacity of 120 million tons (Morrison-Knudsen Engineers, Inc., 1990a). The Poorman site was dismissed from further consideration on the basis of inadequate storage capacity.

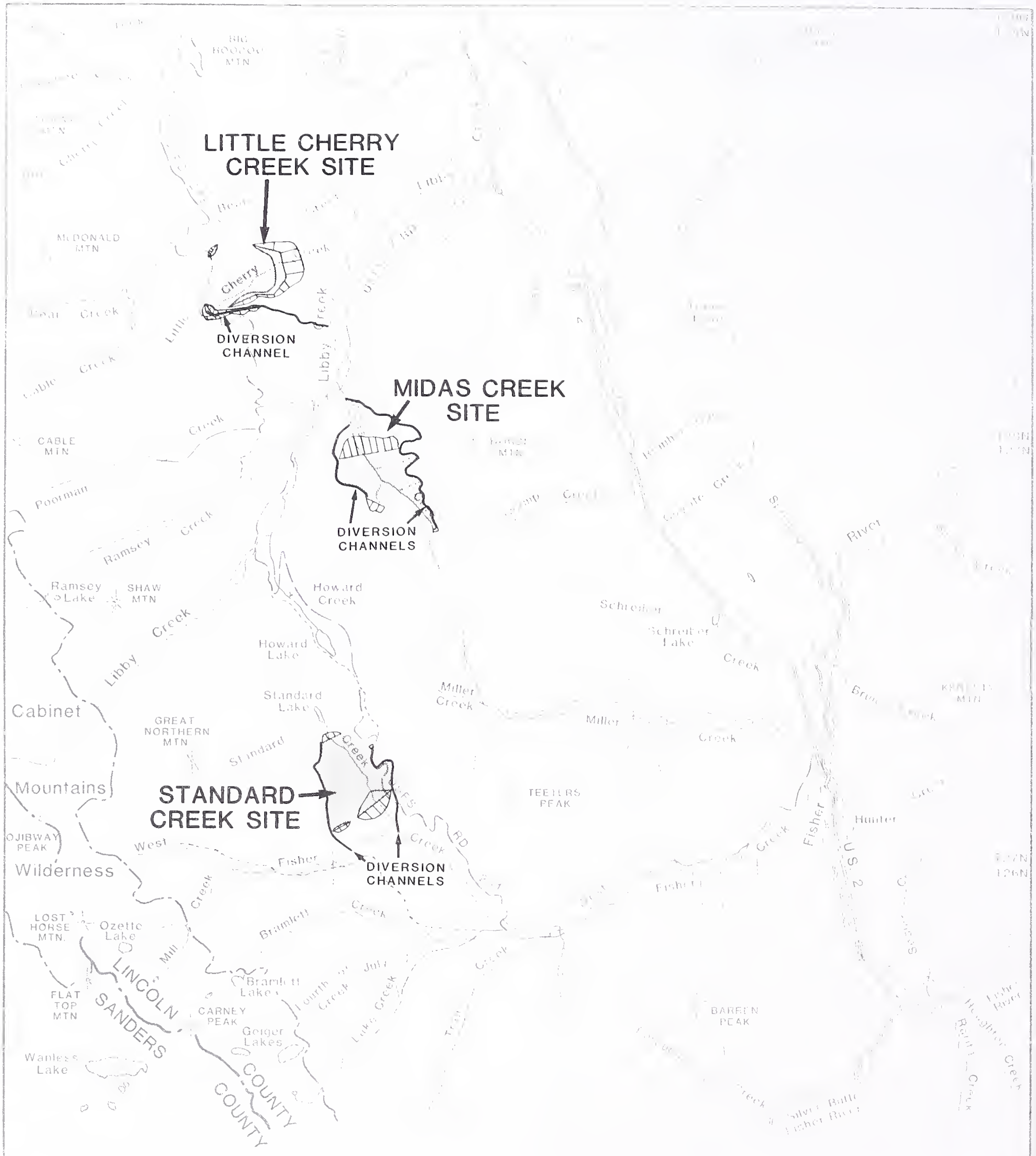
The agencies considered a possible site on Standard Creek during the analysis. Standard Creek was considered by the agencies because it has sufficient storage capacity, and otherwise meets the general criteria required for impoundment siting. The agencies did not identify an alternative tailings impoundment site that would avoid discharge of dredged or fill materials into waters of the United States. The quantity of proposed discharge, the local topography, and drainage patterns preclude such an alternative.

Description of alternatives. The three alternative impoundment site locations are presented in Figure 2-25. The proposed Little Cherry Creek impoundment site is described under Alternative 1. As proposed, the impoundment would cover 460 acres, with a maximum dam height of 370 feet. It would require a permanent diversion of Little Cherry Creek approximately 4,600 feet in length. Under Alternative 2, the agencies would require a longer engineered diversion structure for Little Cherry Creek, possibly doubling the proposed length. Site reclamation would consist of lowering water levels in the impoundment, grading, replacing soil and revegetating.

A Midas Creek impoundment would cover about 370 acres, with a maximum dam height of 460 feet. It would require stream diversions about 23,000 feet in length. A Standard Creek impoundment would cover about 440 acres, with a maximum dam height of 440 feet. It would require stream diversions of about 16,000 feet in length. At both locations, diversions would be required on both sides of the impoundment. Reclamation of both sites would require that flood waters be routed into the impoundment and discharged over a spillway along the dam abutment.

Environmental and engineering considerations. Noranda mapped wetlands at the Little Cherry Creek, Midas Creek and Standard Creek alternative impoundment sites. They also conducted a preliminary analysis of the engineering, environmental and cost considerations for each site. This information was developed into a matrix comparing each of the alternative sites. The agencies reviewed and revised the matrix (Table 2-16). This information is summarized below.

As shown in Table 2-16, all three alternative impoundment sites would affect waters of the U.S. and wetlands. The Standard Creek site would affect 3.1 miles of perennial streams and about 27.6 acres of wetlands and waters of the U.S.; more than the



Source: Noranda Minerals Corp., 1991.

FIGURE 2-25

ALTERNATIVE TAILINGS IMPOUNDMENT LOCATIONS

Table 2-16. Tailings impoundment alternatives matrix.

Engineering Considerations	Midas Creek	Standard Creek	Little Cherry Creek (as proposed by Noranda)
Impoundment Characteristics			
Maximum dam height	460 feet	440 feet	370 feet
Maximum crest length	4,100 feet	5,000 feet	10,000 feet
Final impoundment area	370 acres	440 acres	460 acres
Volume of starter dams	4.2 million CY	4.3 million CY	2.3 million CY
Total volume of final dam	32.5 million CY	21.4 million CY	31.5 million CY
Seepage control at dam	Foundation soils and bedrock generally have very low permeability (10^{-5} to less than 10^{-6} cm/sec). Bedrock is shallower than at Little Cherry.	Site not investigated with field explorations. Based on surface reconnaissance, bedrock may be shallower than at Little Cherry Creek, but soils may be more pervious.	Foundation soils generally have low permeability (10^{-5} to 10^{-6} cm/sec). Bedrock permeability is of the same order as that of the foundation soils.
Long-term stability of dams	Final dam would require a spillway excavated into one of the dam abutments and enough freeboard for the spillway to pass the PMF without overtopping. Artesian conditions were not observed in the foundation, although the potential for artesian pressures unknown.	Final dam would require a spillway excavated into one of the dam abutments and enough freeboard for the spillway to pass the PMF without overtopping. Artesian conditions were not observed in the foundation, although the potential for artesian pressures unknown.	Tailings surface would be graded to drain upstream toward a natural outlet at the backside of the impoundment and into Bear Creek. No spillway or crest freeboard would be required at the dam. Artesian conditions exist in foundation soils and would require control by relief wells (~110). Site partially underlain by deep (300-400 ft.) buried channel.
Length of realigned roads	9,700 feet	3,500 feet	2,500 feet
Cost of starter impoundment	\$20 million	\$21 million	\$11.8 million
Scheduling			
Compatibility w/Noranda's plans and schedules	Would require 2.5 to 3 years for tailings impoundment construction	Would require 2.5 to 3 years for tailings impoundment construction	Would require 1.5 to 2 years for tailings impoundment construction
Costs of delays (Noranda's estimates)	Estimated \$15 million lost interest on investment and 1 year delay in positive cash flow over Little Cherry Creek alternative	Estimated \$15 million lost interest on investment and 1 year delay in positive cash flow over Little Cherry Creek alternative	Constructed per project schedule

Table 2-16. Tailings impoundment alternatives matrix (cont'd.).

Engineering Considerations	Midas Creek	Standard Creek	Little Cherry Creek (as proposed by Noranda)
Surface Water Control			
Watershed area	2,430 acres	3,260 acres	1,140 acres
# of diversion dams required	2	2	1
# of diversion channels	2	2	1
Length of diversion channels	23,000 feet	16,000 feet	4,600 feet
Design diversion channel flow	7,000 cfs west side 7,000 cfs east side	16,000 cfs west side 4,000 cfs east side	5,000 cfs
Estimated flow for 100 year event	148 cfs	187 cfs	81 cfs
Slope of hillside above diversion channels	2:1	2.5:1	4:1
Maximum relief above diversion channels	1,500 vertical feet	3,000 vertical feet	500 vertical feet
Disturbed area (channels)	200 acres	140 acres	40 acres
Stability and maintenance of diversion channels	Hillside instability may be a source of continuing maintenance problems. Diversion channels would be less reliable for long-term reclamation, as they may be subject to blockage by landslide debris during severe storms.	Hillside instability may be a source of continuing maintenance problems. Diversion channels would be less reliable for long-term reclamation, as they may be subject to blockage by landslide debris during severe storms.	Because of the gentle slopes and low relief, hillside instability unlikely. Diversion channels should be reliable for long-term reclamation.
Excavation volume to construct diversion channels	10 million cubic yards	7 million cubic yards	2 million cubic yards
Cost of diversion channel	$19 million	$13 million	$3.75 million
Pipeline Considerations			
Length of pipeline	5.2 miles	7.4 miles	6.4 miles
Pipeline flow	Pressurized pipe required to pump over ridge between Libby Creek and Midas Creek.	Pressurized pipe required to pump over pass west of Midas Point.	Gravity flow
# of creek crossings	2-Libby Creek and Ramsey Creek	2-Ramsey Creek and Libby Creek	1-Poorman Creek

Table 2-16. Tailings impoundment alternatives matrix (cont'd.).

Engineering Considerations	Midas Creek	Standard Creek	Little Cherry Creek (as proposed by Noranda)
Fisheries			
Impacts to fisheries	Nursery fishery and good spawning habitat	Nursery fishery and poor spawning habitat	Nursery fishery and moderate spawning habitat
Miles of total perennial streams affected	2.4 miles	3.1 miles	1.3 miles
Wetlands and "Waters of the U.S."			
Acreage of wetlands and waters of the U.S. affected	6.5 acres	27.6 acres	19.8 acres
Function and value of wetlands affected	Wildlife habitat	Wildlife habitat; waterfowl nesting habitat	Wildlife habitat; waterfowl nesting habitat
Wildlife			
Impacts to wildlife	Loss of summer/fall big game habitat	Loss of summer/fall big game habitat	Loss of summer/fall big game habitat; Loss of moose winter range
Threatened, endangered or sensitive species			
General impacts	Inhibits access to spring grizzly bear habitat on Horse Mountain; affects hybrid redband-cutthroat fish habitat.	Inhibits grizzly bear movement between Cabinet Mountains and habitat east of Howard Lake.	Less impact on grizzly bear movement; less bear habitat physically disturbed; affects Interior redband fish habitat; affects large population of northern beechfern.
Visual Resources			
Visibility	Visible from USFS Road #231, North Libby Creek Point, Libby Divide Trail viewpoint, and Libby Divide Trail	Visible from USFS Road #231, South Vista Point, and Great Northern Mountain viewpoint. Eliminates USFS Road #231 North Vista Point	Visible from USFS Road #231, Horse Mountain, and Snowshoe Peak.

Table 2-16. Tailings impoundment alternatives matrix (cont'd.).

Engineering Considerations	Midas Creek	Standard Creek	Little Cherry Creek (as proposed by Noranda)
Timber			
Acreages of old growth habitat affected (based on field verification)	206 acres	0 acres	132 acres
Recreation			
Roads eliminated or rerouted	USFS #4778	USFS #6745 and 231	USFS #231
General impacts	Impacts Libby Creek road by increased activity and diminishes pleasure of major recreational activity of driving the Libby Creek Road, impacts recreational access to Howard Lake campground	Impacts Libby Creek road by increased activity and diminishes pleasure of major recreational activity of driving the Libby Creek Road, impacts recreational access to Howard Lake campground from both the south and the north.	Impacts Libby Creek Road by increased activity; diminishes pleasure of major recreational activity of driving the Bear Creek Road
Compatibility with Forest Plan			
Management Area designation (based on KNF Forest Plan; MA 13 designations not field verified)	13 and 15; some old growth habitat and some high yield timber areas	2, 13 and 14; includes roadless recreation areas, old growth habitat and managed timber harvest	13 and 14; includes both old growth habitat areas and managed timber harvest areas

other two sites. The Little Cherry Creek site would affect 1.3 miles of perennial streams and 19.8 acres of wetlands and waters of the U.S. The Midas Creek site would affect 2.4 miles of perennial streams—more than Little Cherry—but would affect the least amount of wetlands and waters of the U.S of the three alternatives (6.5 acres). Wetlands acreage associated with each alternative is based on 1987 criteria (Environmental Laboratory, 1987).

Surface disturbance associated with the tailings impoundment and stream diversions would be similar for each of the alternatives. Surface disturbance would total 580 acres at Standard Creek, 570 acres at Midas Creek, and 500 acres at Little Cherry Creek. The figures do not account for borrow material used to construct the tailings embankment. Borrow areas would be temporarily disturbed and reclaimed during the years of early operations. Disturbance at Little Cherry Creek is based on Noranda's proposal. Alternative 2 would require that Noranda increase the engineered length of the Little Cherry Creek diversion, increasing the disturbed acres over that in Noranda's proposal.

Wildlife impacts associated with the three sites would be similar. Little Cherry Creek would affect moose winter range, but slightly less grizzly bear habitat. Grizzly bear movement between available habitat would be less affected at the Little Cherry Creek site. The Midas Creek site would affect more old growth habitat than the other two sites. The Little Cherry Creek site would affect a large population of northern beechfern, a USFS-designated sensitive plant species. The Little Cherry Creek site also would affect Interior redband trout, a USFS-designated sensitive fish species (see Chapter 3).

Subsurface seepage rates may be greater at the Little Cherry Creek site than at Midas Creek, due to the larger impoundment surface area and greater depth to bedrock at the Little Cherry Creek site, and less permeable soils at the Midas Creek site. Long-term effects on water quality in the downstream watersheds would differ only slightly between the two sites. There is insufficient information on the Standard Creek site to estimate subsurface seepage at that site. Indications are that the bedrock may be shallower at the Standard Creek site than at the Little Cherry Creek site, but the soils may be more permeable.

A major difference between the Little Cherry Creek site and the Midas Creek and Standard Creek sites is the watershed area and required diversion channels. As shown in Table 2-16, the Standard Creek site watershed is nearly three times as large and the Midas Creek site is over twice as large as the Little Cherry Creek site watershed. Both the Midas Creek and Standard Creek sites would require two diversion channels and dams. As a result, the Midas Creek and Standard Creek sites would require significantly larger and longer diversion structures than would the Little Cherry Creek site.

All three sites would require specific measures to maintain dam stability. The diversion channels on steep slopes at Midas Creek and Standard Creek could be obstructed by landslides or debris. Channel obstruction could force flood waters into the impoundment where they could overtop, erode the embankment, and affect dam stability. Consequently, the diversion channels would pose a hazard if used for long-term reclamation. Instead, long-term reclamation would require routing flood waters directly over the impoundment to a spillway excavated into the dam abutment. The tailings would require covering with low permeability, compacted soil or synthetic membrane lining to prevent infiltration, and rock riprap or other protection to minimize erosion of the tailings. The dam would also require enough freeboard for the spillway to pass the probable maximum flood without overtopping. Long-term monitoring and maintenance of the embankments and spillway would be required to ensure the stability of the structure.

The diversion channel at the Little Cherry Creek impoundment site could be used as part of long-term reclamation. The Little Cherry Creek site, however, would require measures to relieve artesian uplift

pressures present at the site. Such pressures, if left untreated, could affect tailings embankment stability. Noranda proposes to install pressure relief wells for this purpose. Artesian conditions have not been identified at the Midas Creek or Standard Creek sites and are not considered likely to occur. Detailed studies, however, have not been conducted at these sites.

Summary. All three tailings impoundment alternative sites would affect waters of the U.S. and wetlands. The Standard Creek site would affect more miles of perennial streams and more acres of wetlands than the other two sites. The Little Cherry Creek site would affect fewer miles of perennial streams but more wetlands acres than the Midas Creek site. The function and values of these wetlands could be replaced. The Little Cherry Creek site would affect the smallest drainage area of the three alternatives, and would require the least amount of stream diversions. No spillway or dam freeboard would be required for reclamation at Little Cherry Creek. Reclamation of the Midas Creek and Standard Creek impoundments would require routing of waters onto the impoundment and over a spillway located along the dam abutment. Considering both environmental and engineering factors, the Little Cherry Creek site is the most practicable and least environmentally damaging tailings impoundment alternative. The agencies dismissed Midas Creek and Standard Creek alternative tailings impoundment sites from further consideration.

Tailings Disposal Techniques

Several alternative tailings disposal techniques were evaluated but dismissed from further consideration. These alternatives include conventional backfill of tailings into the mine, partial backfill of tailings into the mine using both coarse and fine tailings, and dry storage of tailings.

Backfilling of tailings into the mine was evaluated to determine whether it could be used to reduce the size of the tailings impoundment, and whether its use would be needed to prevent subsidence (collapse) of the surface overlying the mine.

Conventional underground mine backfilling. Backfilling with tailings has traditionally been used in narrow, steeply dipping mineral deposits for ground support to minimize ore dilution and to prevent collapse of workings, to provide a platform for miners to reach overlying ore, or to maximize ore recovery. It has rarely been used for large, gently dipping deposits or simply as a means of tailings disposal.

When rock is ground into tailings, it increases in volume. This is referred to as bulking. The effect of bulking is that only a portion of the tailings can be backfilled into the mine. Typical cut-and-fill mining operations use as backfill about one ton of tailings for every two tons of ore mined (Wayment and Cuistar, 1982). The theoretical amount of tailings that could be backfilled into the Montanore Project mine would be slightly higher.

Conventional backfilling operations mix water with the tailings to form a slurry. The slurry backfill is either pumped or gravity-fed into the previously mined areas. Only coarse, sand-sized tailings can be used to ensure rapid drainage and backfill consolidation. High percentages of fine tailings in the backfill would inhibit drainage and result in a weak, saturated mass subject to shock loading and fluidization. The majority of tailings expected at the Montanore operation would be fine grained (slimes) and would not be suitable for conventional backfill. Estimates based on the expected Montanore mill grind indicate that about 35 percent of the tailings volume (the coarse fraction) would be suitable for conventional backfill. The remaining 65 percent of the tailings would be slimes and require surface storage.

The size of the surface impoundment would be about the same with conventional tailings backfill compared to Noranda's proposed method of storing all tailings on the surface. With backfill, however, the total amount of surface disturbance would be increased. This is because the coarse tailings used for backfill would be the same material required to construct the

embankment for the tailings impoundment. Approximately 27 million cubic yards of suitable borrow material would be needed to replace the coarse tailings for use in constructing the embankment. The amount of surface disturbance associated with mining this borrow would depend on the specific material and the depth mined. The agencies assumed the replacement material would have an in-place density of 120 pounds per cubic foot and an average borrow depth of 15 feet. Using these assumptions, over 1,000 additional acres would be disturbed.

Conventional backfilling would also require significant changes in the underground operation, and would increase both capital and operating costs. Capital requirements would increase up to 10 percent of planned mine investment and direct mine operating costs might increase by 50 to 100 percent. In addition, the cost to excavate, haul, and place the borrow used for the embankment would be significant.

In addition to evaluating the potential for reducing surface disturbance, the agencies evaluated whether backfill was needed to prevent surface subsidence overlying the mine. This evaluation was based on Noranda's mine plan (Redpath Engineering, Inc., 1991), and an analysis conducted by J.F.T. Agapito and Associates, Inc. (1991). Surface subsidence potential related to Noranda's proposed mining operation is presented in Chapter 4.

Measurable subsidence is not expected as a result of the mining operation. Subsidence would only occur in the unlikely event of widespread mine failure. The potential for such failure can be minimized or eliminated by proper sizing and location of the pillars and by proper sizing of roof spans and location of roof horizons.

Conventional tailings backfill would be much weaker than the rock existing within and above the Montanore deposit. Backfill, therefore, could not be used as primary support in the underground workings or to reduce pillar sizes because it could not support the overburden load. Backfill could be used, however, to fill the voids between pillars and further minimize surface subsidence potential. Should pillar collapse occur, upward propagation of the collapse would be arrested earlier because there would be less void for the collapse to fill.

Conventional tailings backfill was dismissed from further consideration for three reasons. First, use of coarse tailings for backfill would require surface excavation of a significant amount of borrow to replace the tailings for use in embankment construction. This would result in additional and unnecessary surface disturbance. Second, conventional backfill would add to the cost of the operation, and may not be economically feasible. The additional cost would result from increased capital and operating costs directly associated with backfilling, inefficiencies in the mining operation, and the increased cost to excavate, haul and place the replacement borrow material. Third, the need for backfill to further limit subsidence potential is not warranted. Proper sizing and location of pillars and the sizing of roof spans and location of roof horizons would prevent any widespread collapse and consequent subsidence. The planned rock mechanics program should help to achieve a stable design that would prevent surface subsidence.

Partial backfill with coarse and fine tailings. There are two possible methods of using the whole tailings fraction (both coarse and fine) for backfill. One is to use densified whole tailings and the other is to use the whole fraction without densifying the tailings. Under either alternative, as a result of bulking, only a portion of the tailings volume could be used. The advantage of these methods would be to leave some of the coarse tailings for use in embankment construction.

The whole tailings fraction would contain high percentages of fines that would inhibit drainage and result in a weak, saturated mass that would be unstable and dangerous to work around. Stable backfill of whole tailings would require using high density slurry containing 80 percent or more solids by weight. Low permeability fine tailings could be

included in the backfill because the low water content makes free drainage of the backfill unnecessary. Filtering or decantation and storage in a silo would be required to achieve these densities. No one is currently using this approach in the U.S. for large stratiform deposits such as the Montanore Project ore body (Boldt, L., U.S. Bureau of Mines, pers. comm. with B. Thompson, KNF). The U.S. Bureau of Mines is currently studying the use of dense backfills, but the method has not been fully developed yet for use in this type of an operation. This alternative was dismissed from further consideration because it is not a viable technology at this time.

The other alternative would be to use non-densified whole (coarse and fine) tailings to partially fill the mine. This would require mining to begin near the bottom of the deposit working upwards. Whole tailings would then be slurried into the empty stopes after mining is completed in that area. The tailings would remain as a weak, saturated mass. This method would deposit tailings only in the lower mine portion, as placement near and above the underground crusher, haulageways, and adit entrances would pose a hazard to workers and affect ongoing operations.

Since the bottom of the deposit has not been delineated, exactly how much area could be backfilled is not known at this time. Noranda's 135 million ton reserve estimate includes some projection of downdip ore beyond that which is currently delineated. Using the 135 million ton estimate, a maximum of about one-quarter of the tailings could potentially be placed underground. This estimate takes into account the difference in densities between the excavated rock and the tailings. A one-quarter reduction in tailings would reduce the surface area and height of the impoundment by an estimated 15 percent each.

Noranda's proposal is to begin mining near the center of the deposit and to mine upward from there. The lowermost portion of the deposit would not be mined until the end of the operation. This plan is based on economic, timing, and engineering considerations. Part of Montanore's economic potential is tied to the presence of higher grade ore near the center of the deposit. Mining in this area early in the operation is needed to pay for the large capital investment. Indications are that the ore becomes thinner and lower grade toward the bottom of the deposit. Additional time would be required to delineate the lowermost portion of the orebody. Noranda would first have to access the area underground and then conduct detailed drilling to define the lower limits of the orebody. This would require at least an additional year of time, possibly several, and would require significant additional underground workings to reach this area. Plans for adit and underground crusher location are partly based on engineering requirements such as ventilation, haul distances, and acceptable decline grades for adit construction and operation. These engineering requirements would be adversely affected by this alternative,although it is not possible to determine the extent without an engineering plan.

This alternative is dismissed from further consideration. Starting operations in the lower portion of the deposit would significantly add to initial investment costs both in terms of the time delay to delineate the lower end of the orebody, and the cost for additional underground workings to access the lower part of the orebody. The lower grade ore in this area may not generate sufficient revenues to pay for these additional investments. There would be no substantial reduction in size of the surface impoundment under this alternative.

"Dry" storage. Some precious metal mines are using or considering belt filtration (removal of a percentage of liquids) to produce "dry" tailings that can be handled essentially as a solid material. Because of the increased capital and operation costs, filtration is limited to special operating conditions, such as water quality considerations, tailings storage limitations, or reagent recycling (such as cyanide). One mine in Montana, the Jardine Joint Venture project, is

currently using dry tailings storage because of water quality concerns. The mine, however, is much smaller than the proposed Montanore Project and the tailings at Jardine Mine have much higher trace metal concentrations (Montana Department of State Lands and Gallatin National Forest, 1986). No mine as large as the proposed Montanore Project is currently using dry storage disposal methods.

In belt filtration, a series of belt filter devices would be constructed to remove water from the tailings as they move across a filter cloth belt. The tailings moisture content would be reduced to between 15 and 25 percent. The tailings would come off the belts as a cake and be trucked or conveyed to a disposal site. The disposal site would require an embankment to support the tailings and a seepage collection system to collect drainage. Diversion channels also would be necessary.

While technically feasible, the cost of such an approach for a mine the size of the proposed Montanore Project may be prohibitive. A filtration facility and requisite mobile equipment for a 20,000 ton/day operation would cost about $20 to $25 million and could add $1.50 to $2.00 operating costs per ton of ore. A conventional tailings storage system would cost about $0.50 per ton of ore. This alternative was dismissed because the increased costs may make the operation economically unfeasible.

Tailings Embankment Construction Methods

Tailings impoundment dams typically consist of raised embankments, constructed incrementally over the life of the impoundment. Raised embankments usually begin with a starter dike constructed of compacted fill and sized to store one to three years of tailings production. Subsequent incremental embankment raises are staged to keep pace with the dam height required for tailings output. Raised embankments, regardless of the construction materials, generally fall into one of three categories: upstream, downstream and centerline embankments. These categories refer to the direction in which the raised embankment moves in relation to its initial starter dike position. Because of a seismic potential in the project area, the agencies considered Noranda's proposed downstream construction method superior to the other two methods. Since alternative construction methods did not offer environmental or technical advantages to the method proposed, none were considered further.

Other Mine Facilities Siting

Plant sites. Three plant site alternatives were considered during the scoping process. The alternatives considered were—

- Libby Creek at the adit location;
- Little Cherry Creek near the tailings impoundment; and
- Ramsey Creek downstream from the proposed plant site location.

Alternatives to Noranda's proposed plant site were dismissed for a variety of reasons. A site near the Libby Creek evaluation adit was rejected because of a higher avalanche hazard and greater potential impacts to the grizzly bear. (see Figure 3-5 in the following chapter.) Of the three alternative plant sites considered, the Libby Creek site had the highest habitat value for the grizzly bear.

A site location near the proposed tailings impoundment would reduce both visual impacts from the Cabinet Mountain Wilderness and wildlife impacts in the Ramsey Creek drainage. This location was dismissed primarily because of cost and safety considerations. It would require the construction of a conveyor to move ore and waste rock from the mine to the plant and tailings impoundment, greatly increasing capital and operating costs. Higher labor costs would be incurred by transporting workers from a plant site at Little Cherry Creek to the mine. Management of underground operations would be more difficult from a Little Cherry Creek site. Because of the longer adit, response to safety situations underground would be slower.

Locations in Ramsey Creek downstream of the proposed site were considered and dismissed. Impacts to most environmental resources would be similar to the proposed location. Visual impacts would be reduced somewhat with increasing distance downstream, but construction and operating costs would be increased. Avalanche paths on the south side of Ramsey Creek would pose increased safety risk to the mine portal and conveyor system. A longer adit would be necessary to reach the ore body, generating more waste rock. Because worker transportation time would be greater, a longer adit would decrease production efficiencies and increase labor costs. Capital and operating costs would be higher.

Mine access road. Noranda and the agencies considered the Libby Creek Road (USFS Road 231) as an alternative access road in part to avoid disturbing minor acreages of wetlands along the Bear Creek access road. It was dismissed from further consideration because it has more stream crossings and steeper grades than the proposed Bear Creek access road.

Water Treatment Methods

In addition to the three alternative water treatment systems as part of Alternative 3, the agencies considered two other systems, wetlands and electrocoagulation. Based on additional analysis, these two alternatives have been dismissed from further consideration.

Wetland treatment uses selective plants and organic substrate to remove metals in a passive manner. Wetlands are being used most frequently to remove metals from waters affected by acid drainage in the coal and hard-rock mining industries. Although wetlands have proved to be effective at metals removal in acid drainage applications, their effectiveness for the Montanore Project is uncertain. Typically, metals concentrations in acid drainage are several orders of magnitude (10 to 1,000 times) greater than that expected in discharge waters associated with the Montanore Project. Removal efficiencies of wetlands at the very low metal concentrations expected with Montanore Project discharges have not been documented. Although the mechanisms by which metals are removed may still operate at very low metal concentrations, the uncertainty led the agencies to dismiss wetlands from further consideration.

The agencies also dismissed electrocoagulation for similar reasons. It is a relatively unproven technology with little commercial application. Little documentation of the system's efficiencies is available from sources other than the system's vendor. Although the system may be effective in metals removal, uncertainty led the agencies to dismiss electrocoagulation from further consideration.

Power Supply Sources and Transmission Line Routings

Several sources of power and different powerline designs, construction methods, and locations were considered for the proposed mine. Two alternatives were eliminated from consideration early due to their excessive costs and infeasibility. Four other alternatives were evaluated further by Noranda and the agencies, but were ultimately eliminated because they were more costly and did not offer any environmental advantages over the alternatives retained for further study. The alternatives dropped are discussed below.

Mine site generation. Noranda investigated and eliminated the possibility of on-site electrical generation to supply the mine's power needs on a sustained basis. This option would require a gas-fired electric generating plant capable of producing about 55 megawatt, and a new 40-mile natural gas pipeline to the mine from an existing Pacific Gas pipeline. Capital costs for construction of the generating plant and the new pipeline were estimated at $35 million. Operation and maintenance costs associated with this option would be higher than those involving electricity generated elsewhere and brought to the mine by transmission lines. Noranda

and the agencies independently eliminated this option because of high capital costs and the likelihood of additional costs to address environmental considerations such as air quality.

Underground construction. Noranda investigated an option for providing power from Noxon Rapids Dam to the mine site via an underground adit beneath the Cabinet Mountains. This alternative would either tap into the 115-kV system at the Noxon switchyard near the Noxon Rapids Dam or it would connect with the Noxon-Libby 230-kV line where it passes by Noxon Rapids Dam. From the connection point, overhead lines would be built up the Rock Creek drainage for approximately 8.5 miles to a transformation substation built near Rock Lake. The substation would lower the voltage to a level that an underground cable system could carry. Cables installed in a mine adit would extend from Rock Lake underground to the Ramsey Creek plant site. Power would be distributed to the mill and mine complex from Ramsey Creek. The distance from the Noxon site to the Ramsey Creek site is approximately 15.1 miles including 6.4 miles of underground construction. This alternative was initially considered in order to take advantage of a ventilation adit proposed by Noranda in the upper Rock Creek drainage. Noranda has since eliminated the Rock Creek adit from its mine plan, making this alternative infeasible for the following reasons.

Several technical and cost factors weigh against further consideration of underground construction. Underground power from the west side of the Cabinet Mountains would require construction of an adit at a cost between $20 and $30 million. Underground cable and associated equipment installation could add another $30 million. High voltage transmission is not technically practical underground because it requires more sophisticated and expensive conductor technology. The only option for underground transmission is to reduce the voltage. A lower voltage level is not practical because of the type of loads anticipated at the Ramsey Creek plant site. Mine loads would not be adequately served by a cost effective and reliable underground system. Operating costs would be substantially increased by power losses incurred in the voltage transformation and in-line losses between Rock Lake and Ramsey Creek. Increased maintenance, decreased reliability and greater costs to locate and repair underground cable failures also weigh against this option when compared to overhead construction.

Power sources and routing options. Several power sources on the east side of the Cabinet Mountains were considered to serve the mine. One source would require a new line to the mine from a substation located just north of the town of Libby. The substation is owned by Pacific Power and Light Company and supplied by a 115-kV line jointly owned by BPA and Pacific Power. Power is supplied by Libby Dam. The Libby Creek route is about 26 miles long. The transmission line from the substation to the mine would follow south along Libby Creek, passing on the east side of the town of Libby (Figure 2-15). The line generally would follow U.S. 2 and Libby Creek for about 12 miles, turning southwest and generally following USFS Road 231 along Libby Creek. Near the confluence of Libby and Poorman creeks, the route would angle southwest to the mouth of the Ramsey Creek and continue west up the drainage to the plant site.

Computer analysis by Pacific Power and the BPA indicated electrical problems would result if Montanore Project loads were connected at the Libby substation. Connection to the mine would cause low voltage and thermal overload problems to electrical systems in northwest Montana and north Idaho, and costly upgrades would be necessary to provide adequate and reliable power to the mine and other service areas. The transmission line capacity from Libby Dam to the Libby substation over the existing 115-kV line is too small to supply adequately the mine and existing loads under certain outage conditions. As loads grow in the area, these conditions would only worsen if the 115-kV system were used. Approximately 12 miles of 115-kV line from Libby Dam to Libby would have to be

upgraded to enable the Libby substation to supply power to the mine, and an existing 115-kV/230-kV transformer at Libby Dam substation would have to be upgraded. Noranda would have to pay the construction cost.

The BPA recently has announced its plans to reconstruct the electric transmission line from Libby Dam substation to a substation near Bonners Ferry, Idaho, increasing service to the Libby area and providing a stronger source of supply for a load such as that proposed by Noranda. The BPA plans to complete construction of this project within a timeframe that could accommodate Noranda's proposed development. The DNRC has further analyzed this option as a source of supply for Noranda, but has concluded that the option does not present a reasonable alternative to the proposed power supply for several reasons.

Although BPA's planned reconstruction probably would reduce or eliminate the power supply problems associated with a line connecting the mine and the Libby substation, such an option would still require greater expense on the part of Noranda to upgrade the Libby substation to operate at 230-kV. The alternative of constructing a 115-kV transmission line to the mine would reduce the expenses of upgrading the Libby substation, but the lower voltage would result in increased operational costs as a result of greater line losses.

The primary advantage of the Libby Creek route is that it would follow existing transportation and transmission line routes over much of its length. The major disadvantages of the Libby Creek route are that construction costs would be nearly twice that of several other routes; operating costs would be substantially higher than several other routes; and all potential route alignments would pass through and adjacent to a much higher population density, affecting substantially more private land than other routes. There are an estimated 675 dwellings within one mile of its corridor (Noranda Minerals Corp. 1989c).

Supply options dismissed. A number of options for tapping the area's 230-kV system were evaluated. Noranda's loads could be served by a 115-kV line connected to the existing 230-kV transmission system. However, the additional transformers required to convert from 230-kV to 115-kV would make this option more expensive. The power lost in overcoming the line's resistance would be four times higher at the lower voltage, increasing power losses and operating costs. Noranda therefore selected 230-kV as the preferred voltage to serve the mine.

Noranda considered a tap on the Noxon-Libby 230-kV line 7 miles southwest of Pleasant Valley, Montana. This alternative, referred to as Trail Creek, would require a substation tap on the BPA line in a remote area near the junction of Iron Meadow Creek and the Silver Butte Fisher River (T26N, R30W, Section 33). This remote substation location was unacceptable because there is no road to the site and facilities of this size are normally inspected at least once a month, with continuous access to the substation required for equipment repairs or line switching. Use of this remote site would require either costly road maintenance or less reliable service to the mine.

A transmission line from this site to the mine site would cross remote areas (Figure 2-15). From the substation, the line would follow north along Iron Meadow Creek to its headwaters, where it would cross the divide into the Trail Creek drainage. The line would follow Trail Creek north to its confluence with West Fisher Creek. It would then proceed northwesterly along West Fisher Creek and one of its tributaries, Standard Creek, crossing over the divide into the Libby Creek drainage. The line would pass east of Howard Lake, continue in a northwesterly direction across Libby Creek, and turn west along Ramsey Creek to the mine site. The main advantage of the Trail Creek alternative is its relative shortness (approximately 16 miles). Disadvantages of this corridor include crossing areas managed as roadless and other sensitive USFS land management units (e.g., recreation areas and grizzly bear habitat). This corridor would require relatively extensive clearing

and road building. This routing was not retained by the agencies for further detailed study because it does not offer environmental advantages and may have higher potential environmental impacts.

Five alternative routings for the line were evaluated from a proposed tap site on BPA's Noxon-Libby 230-kV line at Sedlak Park west of Pleasant Valley. Three of the alternatives, the proposed action with mitigation (Alternative 4), Alternative 5, and Alternative 6, are discussed in detail in Chapter Four. Two additional routing alternatives were eliminated from detailed consideration because they offered no significant advantages to cost or the environment over the alternatives carried forward for detailed agency review. The two routes eliminated were West Fisher Creek and Miller Creek/Midas Creek options.

The West Fisher Creek route would follow the Fisher River north from the Pleasant Valley intertie site to the confluence with West Fisher Creek, and then would proceed west along West Fisher Creek to near its confluence with Standard Creek (Figure 2-15). The corridor then would proceed north-northwesterly over the divide into the Libby Creek drainage past Howard Lake, and then west along Ramsey Creek to the mine site. The West Fisher alternative is 19.4 miles long. It generally would follow existing roads and would be located at relatively low elevations, providing some advantage for line construction and maintenance. It would be longer than other routes and would cost more. The West Fisher alternative would affect more private landowners than other 230-kV alternatives. It also would affect more national forest users due to its location along a major forest access route.

The Miller Creek/Midas Creek corridor would follow the Fisher River valley from the substation north for four miles, turning west along Miller Creek (Figure 2-15). The route would follow Miller Creek about four miles, and then would turn northwest along an unnamed tributary to Miller Creek. The route would cross the divide into the Midas Creek drainage and follow the east side of this drainage for about three miles, then would turn west, crossing Libby Creek about one mile below the mouth of Poorman Creek. After crossing Libby Creek, the route would turn southwest toward the Ramsey Creek drainage and follow that drainage to the mine site. The route would be about 18.2 miles long. Its increased length avoids private property along Libby Creek. Because of the greater length of this option and the lack of environmental advantages over other alternatives, the agencies dropped this alternative from further consideration.

Transmission Line Construction Methods

H-Frame wood poles. The preferred structures to support the conductors are steel monopoles, which may vary in height from 30-90 feet, depending on topography crossed. H-frame structures were considered and comparative information, when appropriate, was included in the transmission line application (Noranda Minerals Corp. 1989c). The primary reason for choosing the monopole over H-frame structures is that right-of-way and clearing widths would be less with monopoles. Also, steel monopoles would require less maintenance during operation and can be purchased in an assortment of colors, which may ease the visual impact of the transmission line. Although the cost of steel monopoles over H-frame wood structures would be approximately $5,000 per mile more, Noranda and the agencies concluded that the overall environmental impact would be less for steel monopoles.

Helicopter construction. The use of helicopters to erect the transmission line was considered as an alternative to conventional construction methods. The agencies determined that general use of helicopters in line construction would have little environmental advantage since conventional equipment (such as augers) would be required to excavate foundations for the transmission line poles. Disturbance associated with access required to move this equipment to each pole location could not be avoided unless more expensive and time-consuming methods (such as hand digging of pole foundation

holes) were done. Line maintenance costs would also be increased without ground access to each tower. For these reasons, the agencies dismissed this method as a recommended line construction alternative, recognizing that using helicopters could be left to the discretion of the construction contractor.

Joint Venture Mineral Development

Neither ASARCO nor Noranda contemplates entering into a joint venture agreement. Letters were sent to both companies requesting consideration of a joint venture, and both explicitly rejected the idea (ASARCO, Inc., 1988; Noranda Minerals Corp, 1988b). The agencies have no regulatory authority to require a combined operation.

REASONABLY FORESEEABLE ACTIVITIES

Under the National Environmental Policy Act and the Montana Environmental Policy Act, agencies are required to assess the cumulative impacts of a proposed action—the Montanore Project—when added to the past, present, and reasonably foreseeable activities. Any actions connected to the proposed action also requires analysis. The agencies have conducted an analysis of those actions that would constitute a "reasonably foreseeable activity". These activities, discussed in the following sections, include timber sales, the ASARCO Rock Creek Project, other mineral development, road closures, and other miscellaneous activities. There are no actions connected to the Montanore Project that are not included in the agencies' analysis presented in this FEIS.

Timber Sales

Three timber sales are under contract in the project area. Approximately 50 thousand board feet of timber remain to be harvested on one of these sales (Table 2-17). The other two sales are complete except for post-logging slash disposal work (T. Maffei, Libby District TMA, November 1991).

During the 10-year planning period, 8 timber sales are planned in the vicinity of the Montanore Project site (Table 2-17; Figure 2-26). Harvested timber volumes are expected to be 16.0 million board feet from 975 acres. It is estimated that about 17.7 miles

Table 2-17. Current and proposed timber sales in project area.

Sale	Fiscal Year	Volume (mmbf)	Acres	Truck trips	Miles of road work: Construction	Miles of road work: Reconstruction
Current sales						
Donkey Face Salvage	'91-'92	0.1	100	30	0	0
Proposed sales						
Little Hoodoo	'94-'97	1.0	75	200	0	0
Standard/Fourth of July	'95-'98	2.0	100	400	2.0	4.5
Miller Creek	'95-'98	2.0	100	400	7.0	0
Trail Creek	'96-'99	2.0	100	400	8.7	0
Libby/Bear	'97-2000	3.0	150	600	0	0
Midas	'98-2000	1.0	75	200	0	0
Big Hoodoo	'99-2001	1.0	75	200	0	0
Horse/Hoodoo	'99-2001	2.0	100	400	0	0
Misc. salvage and stand tending	'92-2000	2.0	100	400		
Total		16.1	975	3,230	17.7	4.5

Source: Libby Ranger District. 10-Year timber sale program.

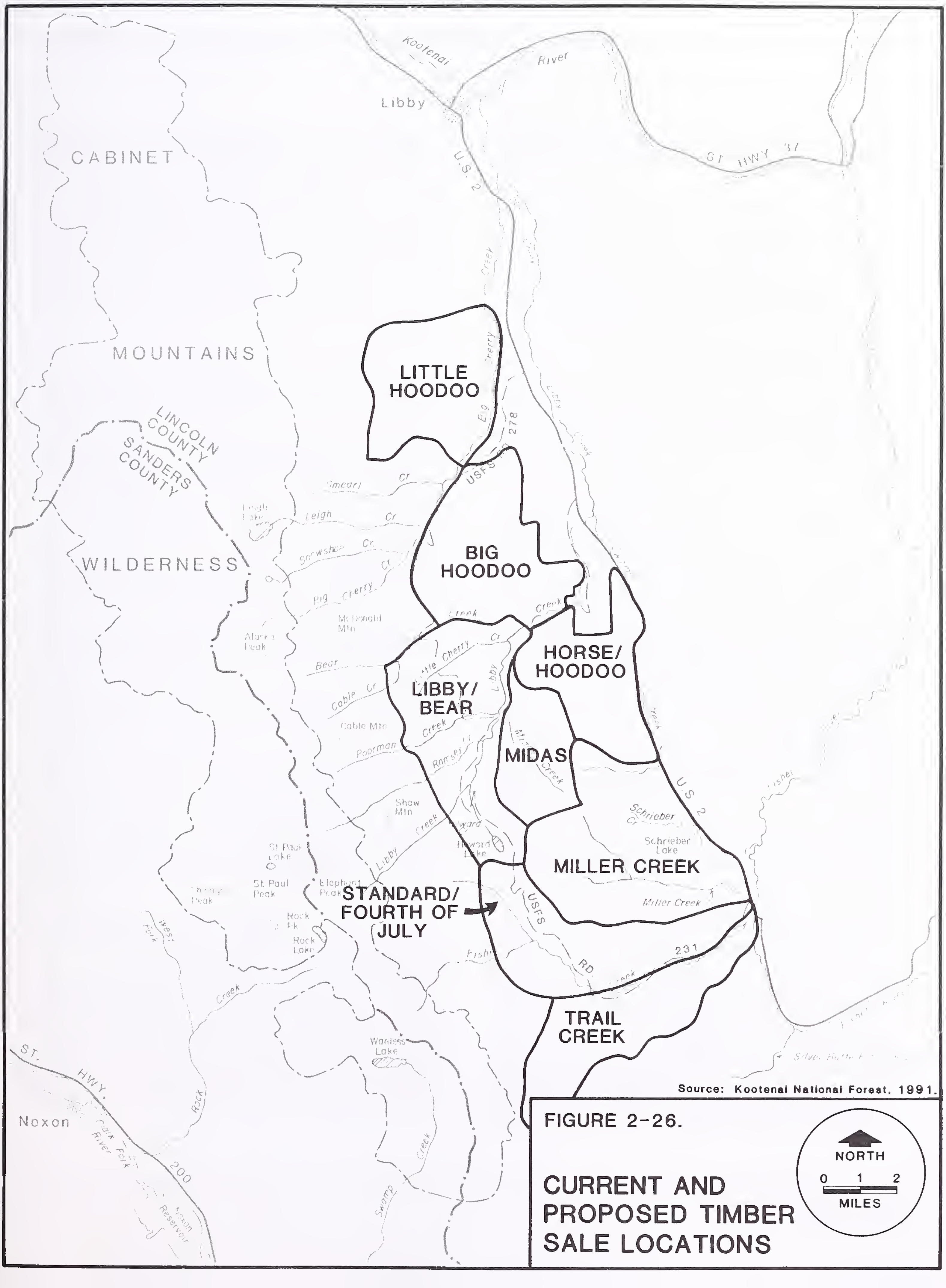


FIGURE 2-26.

CURRENT AND PROPOSED TIMBER SALE LOCATIONS

of road would need to be constructed and about 4.5 miles of road reconstructed in conjunction with these timber sales.

Post-harvest activity on each of these sales may include the following—

- Most of the units would be broadcast burned one year after logging to remove slash and prepare areas for forest revegetation. The other 10 percent of the area's slash would be piled by bulldozer and burned.
- Nearly all the units would be regenerated by planting bare-root stock.
- All newly constructed roads would be closed permanently. Temporary roads would be seeded to mixed grasses for soil stabilization.
- Regeneration monitoring would be conducted in years 1, 3, and 5 after site preparation.
- Other possible activities that may occur include: controlled burning to improve wildlife habitat, installation of structures in streams to provide habitat and allow fish passage, and reconstruction of recreation trails.

This information is based on what has occurred in the past on the Libby Ranger District. What would actually occur on each sale cannot be determined until an environmental analysis is conducted.

Mineral Activities

The potential for additional mining and mineral exploration was estimated for the southwest portion of the KNF. The estimate was based on a ten-year forecast period (1992 to 2002). The estimate of reasonably foreseeable mineral activities is based on—

- current and past levels of activity;
- present market conditions;
- submitted operating proposals;
- known ore reserves; and
- the area's mineral potential.

Within the next ten years, the development of two new copper-silver mines (Noranda's Montanore and ASARCO's Rock Creek), possible development of a heap-leach gold mine (Orvana/Pegasus), the closure and reclamation of ASARCO's Troy Mine, and continued exploration for copper-silver and lode gold deposits could occur in the mineral study area. If approved, the ASARCO and Noranda operations could be in full production by 1995 to 1997. Total production from these two mines could be 30,000 tons of ore per day, with about 19 million ounces of silver and 144 million pounds of copper produced each year.

The Troy Mine may exhaust known reserves in the mid-1990s, corresponding to the possible opening of the Rock Creek and/or the Montanore projects. This closure date might be extended if current exploration in the mine area delineates additional reserves, or if market conditions allow for mining lower grade resources.

It is possible that a heap-leach gold mine could be developed at the Orvana/Pegasus property near Libby. Such development would depend on discoveries made with current exploration drilling activities and the market price of gold. No development plan has been submitted to the agencies.

On average, about ten exploration drilling projects would be conducted each year, nearly all for stratabound copper-silver deposits. This drilling would focus generally in areas of current activity. One or two new areas may be drilled each year. Two miles or less of new roads would be constructed or reconstructed each year for exploration drilling. These roads would generally be reclaimed at the end of the drilling operation. The majority of exploration drilling would likely prove unsuccessful in discovering new ore deposits. No current exploration for copper-silver deposits is occurring in the immediate area of the Montanore Project.

It is possible, based on the area's mineral potential, that a new copper-silver deposit would be discovered within the ten year forecast period. The long lead times necessary to explore and develop such a deposit make it unlikely that a new mine would be constructed within the ten-year period. It is not

possible to predict where such a deposit would be located or how it would be developed.

Kennecott will likely apply for mineral patent on two small copper-silver properties located in the Cabinet Mountains Wilderness adjacent to ASARCO's Rock Creek deposit. Such patenting, if approved, would retain management of the surface with the U.S. Forest Service. Patenting of these properties would not lead to development of a new mine. The ore reserves are too small to warrant development of a separate mine. Any production from these properties likely would be in conjunction with the ASARCO's Rock Creek Project.

Examinations by the Forest Service of additional claims in the Cabinet Mountains Wilderness could determine some claims had valid mineral discoveries prior to the wilderness withdrawal date of January 1, 1984. It is very unlikely that additional major mine development would be associated with any of these claims. Any development would be subject to agency review and approval.

Weekend prospecting, small scale placer and lode operations, and general assessment work will continue at present levels. Most of these activities will be confined to historic mining districts.

The KNF will continue to sell and provide free permits for existing pits and quarries where sand, gravel, and building stone are now obtained. No major development of construction mineral materials is envisioned for this area, with the exception of borrow material possibly needed for construction of the Montanore or Rock Creek projects.

ASARCO's Rock Creek Project

On May 6, 1987, ASARCO, Inc. submitted an Application for Operating Permit and a Plan of Operation for the development of mineral properties near Noxon, Montana. This project is known as the Rock Creek Project. The EIS has been postponed while ASARCO clarifies its Operating Permit proposal. When ASARCO's application and the agency review of all information is complete, the EIS will be finalized and made available for public review and comment.

On July 13, 1992, ASARCO submitted an Application for an Exploration Adit. This project is known as the Rock Creek Exploration Adit.

The KNF and the DSL began a joint process to analyze the impacts of the operation in a single EIS. The following are brief descriptions of ASARCO's Exploration Adit proposal and Operating Permit proposal. ASARCO's proposals may change. The Rock Creek EIS will examine reasonable alternatives to ASARCO's final proposals and the agencies' preferred alternative(s) may be different than ASARCO's proposals.

Exploration adit description. ASARCO proposes to develop an exploration adit for the Chicago Peak orebody in the Cabinet Mountains. The exploration adit would be 6,592 foot long and originate at an elevation of about 5,755 feet. The adit would be 18 feet high by 18 feet wide. The project would use conventional mining methods of drilling, blasting, rock bolting, mucking and truck haulage. Drilling would be done with rubber-tired, electric-hydraulic drill jumbos which drill 14 foot horizontal holes. If substantial groundwater is not encountered, ammonia nitrate/fuel oil would be the primary blasting agent. If wet conditions are encountered, a water based slurry would be used.

Estimated surface disturbance for the adit would be 6.1 acres. The land encompassed by the project is unpatented mining claims on National Forest System lands. ASARCO has filed for patent on these lands. Approximately 178,000 tons of material would be excavated from the proposed adit. This would equal about 132,000 cubic yards of stockpiled waste rock. While the proportion of barren rock to mineralized ore is not currently known, the majority of waste rock would be from the barren zone below the ore body. Waste material would be end-dumped to form a flat-topped pile adjacent to and downslope of the access road. The material excavated from the

mineralized zone would be placed in a stockpile on top of the waste material. The waste rock stockpile would be near the portal.

At the adit site, a 40 foot by 80 foot temporary steel building would be constructed. The building would provide space to maintain mobile equipment, store parts, and supplies and conduct miscellaneous work in the winter. Two 500 KW diesel generators would be located in a covered lean-to attached to the building to provide power for the drills, pumps, vent fans and shop. A diversion ditch around the upper side of the adit site would be used to divert water from the undisturbed areas around the site. Drainage from the top of the dump and around the shop would be routed to the lined pond. Water from this pond would overflow into a pipeline and drain to the Clark Fork River.

The office, mine dry, and employee parking lot would be located on ASARCO property located near the three mile marker of the Rock Creek Road. Power for the office area would be supplied by the local utility through an existing powerline. Forest road No. 150 and the Chicago Peak Road would be used for access. ASARCO would do the minimum work necessary to provide year-round access on the roads. This work would be done in consultation with the Forest Service. Snow would be removed from the roads using a snowplow-sanding truck assisted by a road grader and D-7 dozer when necessary. Snow removal and disposal would follow USFS guidelines. To minimize traffic on the West Fork of Rock Creek and on Chicago Peak Road, crews would assemble at the office and be transported in 4x4 vans to the adit. Maximum personnel would be about 55 people.

Exploration adit water use and management. Water requirements for driving the adit would average 30 gpm during the drilling cycle. Some additional water may be needed for dust control in the adit if it is dry. A small amount of potable water would also be needed for the lavatory and lunchroom in the shop. Potable water would be trucked to the adit site and stored in a tank in the shop until a suitable source is found in the adit. A well would be installed to supply the office. Sewage from the lavatories in the adit shop would report to a conventional septic tank and drainfield system. Sewage from lavatories in the office and from the mine dry at the support facility would report to a holding tank. This tank would be pumped periodically and hauled to a municipal sewage disposal facility.

Mine water would initially be hauled to the site. A small lined pond would be constructed near the portal to collect site runoff and store the hauled water. A pump in this pond would provide mine water during the initial stage. If water is encountered in the adit during this phase, it would be pumped to the pond to reduce hauled water needs. After the adit has advanced to approximately 350 feet, an 18 foot by 18 foot by 40 foot long sump would be excavated at that point to function as the main mine water sump. Water would be pumped from the working face to the sump for the main mine water supply. A pressure filter and an oil skimmer would be located at this sump to remove suspended solids and oil and grease from the water supply. Filtered water in excess of the requirements for the tunnel would be pumped to the portal where it would enter the pipeline to the Clark Fork River for disposal.

This temporary pipeline would be a six-inch diameter polyethylene line located on top of the ground for most of the distance to the river. It would be buried for occasional road crossings or in other areas where it must be protected. It would cut across switchbacks on the upper end to reduce distance and it would cross Rock Creek (following its eastern side) to gain access to the river. The pipeline would be installed to minimize disturbance. The sections of the pipe would be fused together in areas of good access. Long sections of the fused pipe would then be dragged through areas of poorer access with a small crawler tractor or with a cable and winch.

ASARCO's estimated adit water inflow would be about 88 gpm at completion of the adit. The mine

water should be on generally good quality with the possible exception of elevated nitrates. The estimated quantity and quality of this water would be examined in detail in the application for a MPDES permit and the petition for a change in ambient water quality.

Exploration adit schedule. Development of the adit would require three months to mobilize and set up, eight months to drive the adit, and one month to de-mobilize.

Mine description. ASARCO proposes to construct a 10,000-ton-per-day mine and mill complex to extract copper and silver ore from patented mining claims under and adjacent to the Cabinet Mountains Wilderness, about 13 miles northeast of Noxon, in Sanders County, Montana (Figure 2-27). The project is similar in scope and operation to ASARCO's Troy Mine in Lincoln County, Montana.

ASARCO anticipates a 3.5-year construction and development period, with limited ore production beginning after 2.5 years. Full production would last for about 30 years. The mine life would be dependent upon metal prices, engineering, and other factors that determine economic viability. Post-mining reclamation is estimated to require two years to complete.

ASARCO would use an underground room-and-pillar method. The on-site ore processing complex would crush and grind ore to liberate metal-bearing sulfides. Sulfides would then be removed by flotation, dewatered, and trucked to the Noxon railroad siding to be shipped to an off-site smelter. Tailings from ore processing would be deposited in a tailings impoundment north of U.S. 200 near its junction with Rock Creek Road. Additional project facilities would include an access road, utility corridor, surface conveyor, office building, shop, and warehouse.

The proposed permit boundary would encompass approximately 2000 acres. Land encompassed by the permit boundary is about 1/3 privately held and 2/3 administered by the Forest Service.

Mine plan. ASARCO would develop an underground mine producing 10,000 tons of ore per day, or 3.6 million tons per year. Current ore reserves are approximately 144 million tons at 1.65 ounces per ton of silver, and 0.68 percent (14 pounds per ton) copper. Overall ore extraction is expected to be 70 percent, giving the mine an anticipated production life of 30 years.

Preproduction development would include drilling two parallel inclined adits directly northeast of the plant site. Adit portals are proposed outside the wilderness boundary. The north adit would be a conveyor adit and the south a service adit for mine access. Small portal patios would be associated with each adit.

A ventilation adit is proposed within the wilderness boundary. The ventilation opening in the wilderness area would disturb less than 800 square feet of surface. Since this opening would be driven from inside the mine to the surface, essentially no waste rock would be deposited on the surface at the opening; the disturbed area would be limited to the opening.

Conventional methods of drilling, blasting, rock bolting, and mucking would be used. Broken ore would be reduced by underground crusher and then removed to the surface via conveyor belt for further crushing. A surface conveyor would transport ore from the portal to a mill. Ore mined during the preproduction period would be stockpiled at the plant site for treatment after completion of mill facilities. During preproduction, an estimated 600,000 tons of waste rock would be produced. A portion would be fill for the plant site and the remainder would be dumped in an area below the access road. During the production period, waste rock would be stored in previously mined areas

Surface disturbance would result from the mine access road, service and conveyor adit portals, waste rock storage area, the plant site area and surface conveyor, tailings impoundment, land application disposal sites and utility corridor.

FIGURE 2-27.

PROPOSED ROCK CREEK PROJECT AREA

Ore processing and shipment. The ore processing facility would consist of an underground primary crusher, a secondary crushing plant, concentrator, tailings thickener, drainage sumps, pumps, and slurry and water lines. An office building, changing house, and shop warehouse would also be located at the plant site.

The milling process involves six major steps-primary crushing, secondary crushing, grinding, flotation, concentrate dewatering, and tailings storage. Crushing, grinding, and flotation produce both sulfide concentrate and waste tailings. Concentrates are then pumped to a thickener where some water is removed from the slurry. After further dewatering, concentrates are deposited in a bin and put into haul trucks by a front-end loader. Approximately 51,000 tons per year of concentrate would be trucked to the Noxon railroad siding via Forest Service Road No. 150 and U.S. 200. The ore processing plant would operate 7 days a week, 357 days a year for a total processing capacity of 3.6 million tons/year.

Tailings storage. The proposed tailings impoundment area is located approximately three miles southeast of Noxon, northeast of Montana U.S. 200, near the confluence of Rock Creek and the Clark Fork River. The majority of the impoundment would be located on private land in Section 28, T26N, R32W, extending on to National Forest System lands to the east and north. The Cabinet Mountains are located immediately to the north, east, and southeast, with maximum elevations of about 7,500 feet. The impoundment area ranges in elevation from 2,360 to 2,700 feet. Over a 30-year production life, approximately 100 million tons of tailings would be stored in the proposed impoundment.

An initial starter dam would be constructed with nearby borrow materials and would provide tailings storage during initial operation stages. Due to the area's topographical features, two initial impoundments would be operated. Embankments would be incrementally raised to provide additional storage capacity, using the upstream construction method. With this method, the crest of the expanding embankment section is progressively shifted upstream of the original starter dam crest. As embankments are raised, the two impoundment areas would join, forming a single storage facility ultimately covering 324 acres. The embankment would need to be raised about 250 feet to a peak elevation of 2,685 feet to provide sufficient capacity to store tailings.

Water use and management. During full production, the mill would require 3,048 gallons per minute (gpm) of process water. This water may come from the following sources: mine adit water, fresh water wells, waste water from sewage treatment, plant site runoff, thickener overflow, and reclaimed water from the tailings impoundment. A well capable of supplying full make-up water requirements would be installed in Rock Creek alluvium.

ASARCO has estimated that up to 2,000 gpm of mine inflow water may be encountered. The water would be contained and channeled to two 100,000-gallon mine sumps for settling and storage. Water would be recycled for mining operation use, and any excess water would be used in the concentrating process, or discharged to the Clark Fork River. Excess water would be conveyed to the river via a 12 inch buried pipeline. The pipeline would be bored under the highway and railroad.

A sewage treatment facility would be incorporated into the plant design. Sewage effluent would be disposed in the tailings impoundment, and sludge would be disposed at an approved off-site facility.

Roads. To reach the proposed plant site area, vehicles would leave U.S. 200 and travel on USFS Road 150 for about eight miles. A portion of this road is located in the proposed tailings impoundment area and would require rerouting. A new bridge over Rock Creek would be required at the junction of the new and existing roads.

For public safety and plant security, ASARCO proposes relocating Road No. 150 about 4,800 feet from the proposed plant site. These access roads

would be upgraded and paved to handle the projected traffic load. Two additional roads would be required to access the mine portals and the surface conveyor transfer point. Main access road maintenance would be ASARCO's responsibility, unless additional use by the Forest Service or other interests warrants a cost share agreement. Maintenance responsibility would revert to the Forest Service upon mining activity completion.

Utilities. Electrical service to the plant site would be 230-kV, 3 phase, 60 cycle, provided via a new, overhead line from an existing substation near Noxon Rapids Dam. The line would be less than 10 miles long. An outdoor substation at the plant site would transform the 230-kV service to 4.16-kV for plant distribution, and 13.2-kV for mine distribution. Energy needs at the tailings impoundment would be met by a smaller substation, located 0.8 mile from U.S. 200, adjacent to the mine access road. Annual power consumption is estimated at 95 million kilowatt-hours, with a peak demand of 13,300 kilowatts.

Mine employment. The preproduction phase would entail access road construction; mine development; surface plant construction; plant access road renovation; tailings embankment construction; and installation of service facilities. This phase is estimated to employ 34 workers the first quarter and 465 employees in the fifth quarter over a 36-month period. The vast majority of these positions would be temporary contract labor jobs.

Following the initial phase, the underground facilities, surface plant, and mine/mill complex would be brought to full production over a 6-month period. Personnel would increase accordingly from 305 in the first quarter of this second phase, to 355 in the third quarter, where permanent employment is projected to stabilize.

Road Closures

Forest standards (Kootenai National Forest, 1987, Appendix 8) for open road density in areas managed for grizzly bear habitat specify a maximum average density of 0.75 miles of open road per 640 acres. The KNF evaluates compliance with this standard for each timber compartment. Current open road density exceeds the standard for compartments 36, 37, and 43; these compartments would be affected by the Montanore Project. The KNF will permanently close 22.3 miles of National Forest System roads by September 1, 1992 to be in compliance with this standard (Table 2-18). The proposed KNF road closures are shown in Figure 2-28.

Other Developments

Lands owned by Plum Creek Timber Company (PCTC) are mixed with lands managed by the KNF in the Barren Peak, Jumbo Peak, Silver Butte, Blacktail Peak, and Vermillion areas. This area is about 5 to 22 miles southeast of Noranda's proposed plant site on Ramsey Creek. The KNF and Plum Creek Timber Company are currently evaluating alternatives for managing these mixed lands. Possible options include exchange of some or all PCTC lands to the KNF in this area for other public lands on the Forest, and providing access across

Table 2-18. Roads proposed for closure.

Road no.	Road name	Miles
385	Miller Creek	0.8
2317	Lower Poorman	1.7
4724	South Miller Creek	1.0
4725	North Fork of Miller Creek	3.7
4726	South Fork of Miller Creek	2.1
4777	Howard Creek	1.7
4778	Howard Creek	1.6
4783	Lower Cable Creek	1.1
6200	McDonald Mountain	2.2
6210	Ramsey-Libby	2.0
6212L	Little Cherry	0.6
6214	Cable-Poorman	3.4
	Spur to Ramsey Creek	0.4
Total		22.3

Source: Libby District, KNF. 1990.

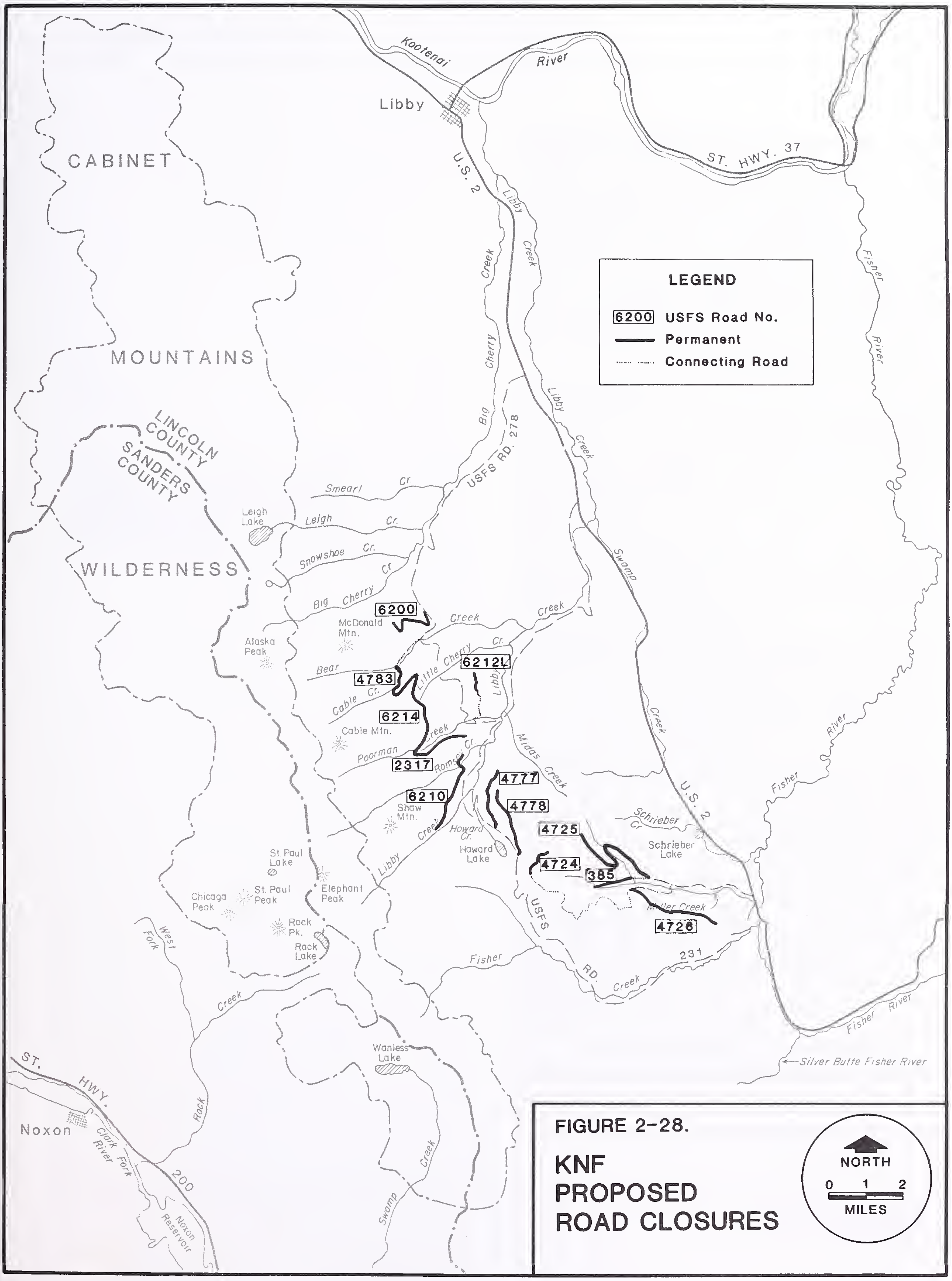


FIGURE 2-28.

KNF PROPOSED ROAD CLOSURES

KNF managed lands with associated timber harvest on PCTC lands. An environmental impact statement is being prepared and public scoping has been initiated. A portion of the affected lands are within a grizzly bear management unit that would be affected by the Montanore Project. Since alternatives are still being developed and no decision has been made, the cumulative effects on grizzly bears of the potential land exchange or road access is not known at this time. These possible cumulative effects are discussed in general in Chapter 4.

Libby Ski Search, a group of local citizens, has been working on a plan to develop a ski area on National Forest lands on Treasure Mountain near Libby. The group has completed a feasibility study for the project, and has formally proposed development. The Forest Services is currently evaluating the project's feasibility. If feasible, the group would need to apply for a special use permit from the KNF, and the appropriate level of NEPA documentation would be required. This action is not considered "reasonably foreseeable" at this time within the context of NEPA or MEPA since no special use permit application has been filed, and no public review process has been initiated.

The Montana Department of Transportation and the Federal Highway Administration are currently preparing NEPA documentation on the proposed reconstruction of 12.2 miles of U.S. 2 southeast of Libby. The proposed project area extends from near Libby Creek to near Miller Creek, along the current highway route. This project is mostly outside of the area affected by the proposed Montanore Project. Limited areas near Libby and Miller Creeks potentially could be affected by both projects. Increased traffic may occur near the Libby Creek road junction as a direct or indirect result of the Montanore Project. The highway construction would end at Miller Creek near the area crossed by the transmission line for Alternatives 5 and 6. These limited cumulative effects are discussed in Chapter 4.

3

THE AFFECTED ENVIRONMENT

NORANDA has conducted extensive studies to characterize the environmental resources of the proposed project area. Studies have been conducted in cooperation with the agencies by specialists in more than a dozen disciplines. (Study methods are described in Chapter 6 of this EIS.) Some environmental monitoring is continuing and would be continued for the duration of the project.

The proposed project area comprises a 3,424-acre mine permit area and a transmission line corridor. About 1,272 acres are proposed for surface disturbance in the project area. The project area is situated in the Kootenai National Forest, 18 miles south of Libby in northwestern Montana. Elevation of the project area ranges from 2,600 feet along U.S. 2 to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is largely influenced by elevation and topography. Two tributaries of the Kootenai River, Libby Creek and the Fisher River, provide surface water drainage.

Public lands are managed by the KNF under the multiple use policies of the KNF Forest Plan. Small areas of private land occur in the project area. Timber harvesting, recreation, and wildlife habitat are the predominant land uses.

This chapter is a synopsis of environmental baseline information compiled by Noranda in permit applications submitted for the project (Noranda Minerals Corp., 1989a and 1989c). Other sources of information also are cited. In the following sections, "project area" refers to an area surrounding all project components—mine, mill, tailings impoundment, adits, land application disposal areas, access roads and transmission line corridor. Within the project area are the "mine area" and the "transmission line corridor area."

METEOROLOGY AND CLIMATE

The region has a "modified continental maritime" type of climate. The regional climate is influenced and modified by Pacific Ocean maritime air masses.

Summers are warm and dry and winters are cold. The Pacific Ocean influences development of coastal storms, which occasionally track across the state of Washington, east into northern Idaho and Montana. The relatively high mountain ranges to the west and north tend to reduce the effects of these storms, so that most rain or snow occurs on the west or north side of the Cabinet Mountains, with drier conditions in the project area.

In winter, cold Canadian air masses can cause periods of extremely cold temperatures. Cold air movement into the region forms temperature conditions which may trap pollutants near the land surface. More frequently, dry continental air masses from Canada or the east influence the region. In summer, these air masses create conditions of warm temperatures and low humidity.

Project Area Climate

Although similar to the regional climate, the climate of the project area is highly influenced by local terrain and elevation. The project area's mountainous terrain produces significant precipitation and temperature variations. Project area elevations range from 2,600 feet along U.S. 2 to almost 8,000 feet at Elephant Peak in the Cabinet Mountains. The town of Libby is about 2,000 feet above sea level.

Atmospheric stability. Atmospheric stability is a measure of small-scale air movement. Stability is an indicator of how readily air pollutants may be dispersed; pollutants will generally disperse more in unstable air. Stability monitoring results, shown in Table 3-1, indicate that the more stable classes, D, E, and F, are predominant at the site.

Wind. Wind velocities vary according to terrain features, with higher wind speeds at ridge tops and lower wind speeds in protected valleys. The upper level winds (above 10,000 feet) come from the northwest, and surface winds follow topographic relief (valley flow) in times of low weather activity. The wind speed minimum, maximum and frequency values for two monitoring locations are shown in Table 3-2. Over 50 percent of the winds at Ramsey Creek and nearly 90 percent of the winds at Little Cherry Creek are less than 3.5 mph. The average wind speed at Ramsey Creek for the baseline monitoring year was 5 mph. The highest wind speed recorded was 28.4 mph at the Ramsey Creek site in the first quarter of the year. Wind speed averages 2.4 mph at the Little Cherry Creek site, which is lower than that reported at Libby (U.S. Dept. of Commerce, 1968) and the East Fork Rock Creek (TRC Environmental Consultants, Inc., 1987).

Figure 3-1 presents the wind rose (frequency distribution of wind directions and speeds) for the

Table 3-1. Stability class distributions (%).

Stability class	Little Cherry Creek	Ramsey Creek
A	17.8	12.5
B	10.1	9.9
C	9.7	8.9
D	10.3	24.1
E	11.3	16.7
F	40.8	27.9

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 8 and 10.

Table 3-2. Wind speed distributions.

Wind speed (mph)	Little Cherry Creek	Ramsey Creek
	———Frequency (%)———	
0-3.5	87.09	57.23
3.6-6.90	11.40	21.67
7.0-11.5	1.48	14.70
11.6-18.4	0.02	5.77
18.5-24.2	0.02	0.52
>24.3	0.00	0.01
Average speed:	2.4 mph	5.0 mph
Maximum speed	19.7 mph	28.4 mph

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 9-10.

Little Cherry Creek and Ramsey Creek monitoring locations. Predominant wind directions are from the southwest-to-southeast sectors. At Ramsey Creek, the measured predominant wind direction contrasts with the orientation of the creek drainage (southwest-to-northeast), and the tendency for upper level winds to be northwest. Libby's prevailing winds are east-to-southeast with an average annual speed of 6.0 mph (U.S. Dept. of Commerce, 1968).

Precipitation and evaporation. Annual precipitation in the project area, which is influenced primarily by the mountains, may vary from 10 to 100 inches. The annual precipitation measured at Little Cherry Creek during the 1988 baseline year was 9.56 inches (Table 3-3). This compares to average annual precipitation at Libby of 19.1 inches. Other area precipitation measurements indicate much higher amounts (up to 100 inches) are possible (Noranda Minerals Corp., 1989a). The amount of precipitation recorded was considered atypically low and not used in designing tailings impoundment facilities.

Table 3-3. Precipitation measured at Little Cherry Creek.

Time period	Precipitation (in.)
Quarter 3, 1988	1.00
Quarter 4, 1988	3.85
Quarter 1, 1989	2.48
Quarter 2, 1989	2.23
Period of Record	9.56

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 8 and 10.

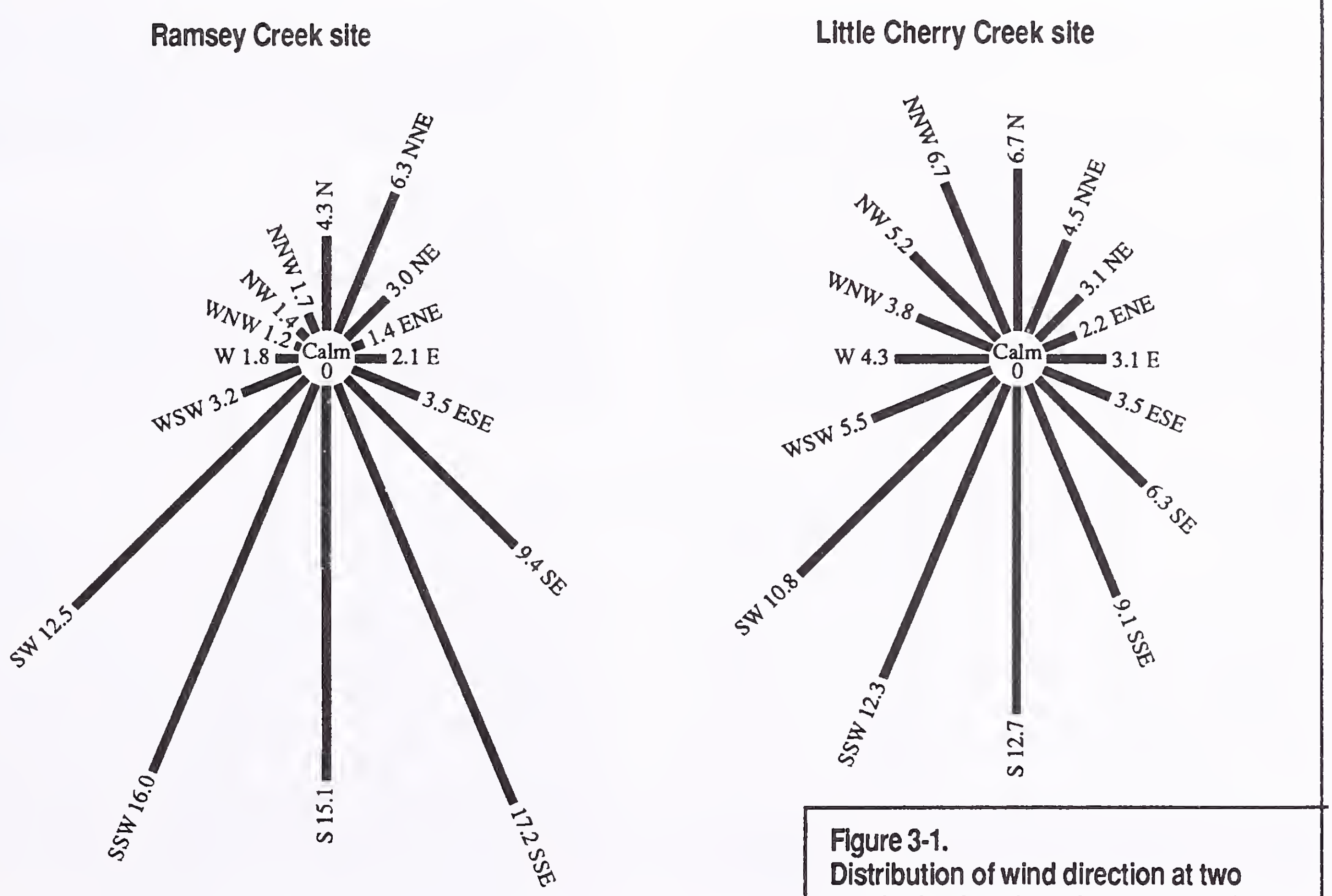


Figure 3-1.
Distribution of wind direction at two monitoring locations, in percent of time

Precipitation occurs as snow in winter with accumulations at the mine site totaling about 90 inches during mid-March (P. Farnes, SCS Water Supply Specialist, pers. comm. w/ T. Ring, DNRC, January 2, 1989). Rain-on-snow may also occur in mid-winter and early spring which can result in significant runoff events.

The average relative humidity for the monitoring year was 61 percent. Reported averages for northwestern Montana range from 65 to 75 percent. Evaporation during the very dry baseline year was 35 inches. .

Temperature. Temperatures in the project area are cold in the winter and mild in the summer. The annual average temperature is about 5°C with a range between -32.3°C and 34.8°C (Table 3-4).

AIR QUALITY

Airborne Particulates

The concentrations of total suspended particulates (TSP) and particulate matter smaller than 10 micrometers (μm) (PM-10) at the monitoring locations are in compliance with annual state and federal air quality standards. The annual arithmetic and 24-hour maximum PM-10 standards are 50 micrograms per cubic meter (μg/m^3) and 150 μg/m^3, respectively, and the annual geometric and 24-hour maximum TSP standards are 75 μg/m^3 and 260 μg/m^3, respectively. Air monitoring information is summarized in Table 3-5.

Table 3-5. Particulate concentrations measured at Little Cherry Creek and Ramsey Creek.

Parameter	Little Cherry Creek (μg/m^3)	Ramsey Creek #1 (μg/m^3)	Ramsey Creek #2 (μg/m^3)
PM-10			
Average	14	12	13
24-hour maximum	189	157	153
TSP			
Average	33	not collected	
24-hour maximum	267	not collected	

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 13-15.

The maximum measured PM-10 and TSP values each exceeded their respective standards on one occasion in the fall of 1988. These values may represent an anomalous event, such as numerous forest fires in the region, and do not represent normal background conditions (Woodward-Clyde Consultants, Inc., 1989a).

The Montana Department of Health and Environmental Sciences operates a PM-10 monitoring site at the Lincoln County Courthouse near the center of Libby. In 1988, PM-10 levels in Libby averaged 64 μg/m^3 and exceeded the 24-hour

Table 3-4. Temperatures measured at Little Cherry Creek and Ramsey Creek (in °C).

Time period	Little Cherry Creek Min.†	Little Cherry Creek Max.	Little Cherry Creek Average	Ramsey Creek Min.	Ramsey Creek Max.	Ramsey Creek Average
3rd Quarter, 1988	-2.1	32.8	14.8	-5.0	34.8	13.1
4th Quarter, 1988	-18.5	17.2	0.2	-23.3	27.0	1.0
1st Quarter, 1989	-31.3	12.0	-4.6	-32.3	14.5	-4.0
2nd Quarter, 1989	-13.5	26.7	6.7	-8.3	29.6	8.5
Period of record	-31.3	32.8	4.3	-32.36	34.8	4.7

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 9-10.
†Minimum and maximum values are hourly averages.

standard for fifteen days. The maximum 24-hour concentration was 256 µg/m³. Airborne particulate levels in Libby and nearby residential areas are substantially above the health-based PM-10 standards.

The State of Montana is developing an emission control plan to bring the Libby area into compliance in response to the high PM-10 levels and associated health risks. The plan will require reductions in emissions from existing sources and severely limit the type of new air pollution sources which can be permitted in the area.

Much of the technical studies necessary to develop the control plan is already complete. These studies indicate that the primary emission sources contributing to noncompliance are residential wood burning and street dust caused by vehicle traffic. Other sources include automobile exhaust, the Champion International facilities, and forestry slash burning.

Trace metal concentrations in suspended particulates are low. None of the monthly values exceed any federal ambient standard or Montana guideline concentration.

Gaseous Pollutants

No measurements of other criteria pollutants, such as carbon monoxide, sulfur dioxide, ozone, nitrogen oxides, or hydrocarbons were made in the project area. Given the remoteness of the project area and the lack of significant air pollution sources, low background levels are assumed.

Visibility

No visibility measurements have been made at the plant site. It may be assumed that visibility is usually high, except during times of forest fires, or controlled burning. The nearby Cabinet Mountains Wilderness is classified as a Class I Prevention of Significant Deterioration (PSD) area. This designation is for those areas of the country (such as National Parks and wilderness areas) where little or no air quality degradation is allowed. In addition to strict ambient air quality standards, visibility protection is also required. PSD issues are discussed in greater detail in the following section.

PSD Designation and Issues

Under the Prevention of Significant Deterioration regulations, the proposed project area is designated as Class II and the Cabinet Mountains Wilderness is Class I. The following is a brief description of PSD regulations.

The PSD program was originally enacted by the U.S. Congress in 1977 and the authority to implement the provisions was subsequently delegated to the State of Montana by the EPA. The goals of the program are—

- to protect public health including the prevention of significant deterioration in areas where ambient air quality standards are being achieved;
- to emphasize the protection and quality in National Parks, wilderness areas, and similar areas of special concern; and
- to ensure that economic growth in clean areas occurs only after careful deliberation by state agencies and local communities.

Unlike the enforcement of the National Ambient Air Quality Standards, the PSD program is implemented primarily through the use of pollutant increments and area classifications. An increment is the maximum increase (above a baseline concentration) in the ambient concentration of a pollutant that would be allowed in an area. Increment systems have been in place for particulate matter and SO_2 for a number of years and have been recently adopted for nitrogen oxides. The area classification scheme establishes three classes of geographic areas and applies more stringent increments to those areas recognized as having higher air quality values. Class I areas are accorded the highest level of protection by allowing the smallest incremental pollutant increase.

The proposed project does not fall under PSD requirements because the source is under the regulatory 250 ton/year emission threshold which characterizes

a "major stationary source." PSD requirements, however, will be discussed in the impact analysis of Chapter 4 to ensure that all potential impacts are addressed.

GEOLOGY

The project area lies within the northern Rocky Mountain physiographic province and is situated on the eastern flank of the Cabinet Mountains in northwestern Montana. The project area is bordered on the east by the Fisher River valley, the lowest topographic feature in the project area. The Sedlak Park substation site is located in the Fisher River valley at approximately 2,800 feet elevation. To the west, the Cabinet Mountains rise to an elevation of 7,938 feet at Elephant Peak. Elephant Peak is the highest peak in the project area and is located on the divide separating the Rock Creek and Libby Creek drainages.

Steep-sided mountain valleys are found throughout the project area. Steep cirques are found at the heads of most valleys in the western portion of the project area. The mountain sides are sparsely to heavily forested; timberline occurs at about 7,000 feet.

Regional Geology

A thick series of metasedimentary rocks of late Precambrian age known as the Belt Supergroup underlies most of northwestern Montana (Johns, 1970). These rocks were originally deposited as unconsolidated sand, silt, and clay, and as carbonate. Subsequent regional low-grade metamorphism altered the sediments to form quartzite, siltite and argillite.

At least two ages of igneous rocks intrude the Belt Supergroup. Rocks high in iron and magnesium of Precambrian age intrude the Wallace, Burke and Prichard formations (Wells et al., 1981). Granodiorite and quartz monzonite plutons (igneous rock types which have intruded beneath the earth's surface) of Cretaceous age occur in the Dry Creek area in the northern part of the Cabinet Mountains Wilderness. Some metamorphism has occurred at the contact between these plutons and the metasedimentary rocks.

The region was significantly folded and faulted during mountain building of late Cretaceous to late Tertiary time. Block faulting occurred in the late Cenozoic Era. Folding consists of large, tight to open, symmetrical and asymmetrical folds, primarily trending northwest or north (Johns, 1970). Major faulting postdates folding and is oriented northwest to north, paralleling the fold axes.

Structural anticlines are present in the Cabinet Mountain Range near the north and south ends. The southern anticline, called the Snowshoe Anticline, is cut by the Snowshoe fault and its branches. The crest of the anticline is parallel to the Rock Lake Fault for more than six miles (Wells et al., 1981).

Extensive glaciation and erosion followed the uplift of the Cabinet Mountains. Northwestern Montana, including the project area, has been glaciated several times. During the most recent glaciation, the continental ice sheet advanced into northwestern Montana and Idaho, blocking the Kootenai River valley and the Clark Fork river valley (Johns, 1970). Geologic evidence indicates glacial lakes deposited fine-grained silts and clays along the Fisher River, West Fisher Creek, and the lower portions of Miller Creek. Glaciofluvial deposits also can be found in terraces along some drainages within the project area. Glaciation in the project area is evident by truncated ridges between the project area stream valleys.

Geology of the Mine Area

The ore deposit proposed for mining is one of several stratiform copper deposits occurring in a belt about 120 miles long and 40 miles wide, extending from British Columbia to the Coeur d'Alene mining district in Idaho (Banister et al., 1981). The mine area stratigraphy consists of metasedimentary deposits of Precambrian age (Belt Supergroup) and unconsolidated deposits along valley bottoms. Bedrock formations include (from oldest to youngest) the Prichard, Burke, Revett, St. Regis,

and Wallace formations (Table 3-6). The Burke, Revett, and St. Regis formations comprise the Ravalli Group. Narrow, unconsolidated deposits consisting of glacial gravels, and modern alluvium and colluvium are found along upper Libby Creek and Ramsey Creek valleys.

Table 3-6. Bedrock stratigraphy of the mine area.

Formation name	Lithology description	Thickness (ft.)
Wallace	Grayish-green, calcareous argillite and siltite, with limestone and dolomite	10,000
St. Regis	Purplish-grey and greenish-gray argillite and siltite	500
Revett	White quartzite and gray siltite; contains silver/copper mineralization	2,500
Burke	Light-gray siltite	4,800
Prichard	Black and white laminated argillite and siltite	9,000

Sources: Noranda Minerals Corp., 1989a; Wells et al., 1981; and Johns, 1970.

The area geology is shown in the mine area geologic map and cross section (Figure 3-2). The structure containing the ore body is a breached, overturned syncline, which plunges to the northwest (Figure 3-2). The overturned syncline is bound on the west by the Rock Lake Fault and on the east by the Libby Lake Fault. The Rock Lake Fault is over 30 miles long. At St. Paul Pass, the fault trends N30°W and dips steeply to the east. Displacement is reported to be 2,500 feet near St. Paul Lake (Banister et al., 1981).

The ore body occurs in the Revett Formation, which is subdivided into the upper, middle and lower Revett, based upon the amount of quartzite, silty-quartzite, and siltite. The majority of the silver/copper mineralization occurs in the upper portion of the lower Revett. The mineralized zone lies on the lower limb of the overturned syncline, and is truncated on the west by the Rock Lake Fault (Figure 3-2). The mineralization is predominantly copper and copper-iron sulfides, including bornite, chalcocite, and chalcopyrite. Silver occurs as native silver. Lead sulfides (galena) and iron sulfides (pyrite and pyrrhotite) occur as a halo around the ore zone, but do not occur in any significant quantities within the zone.

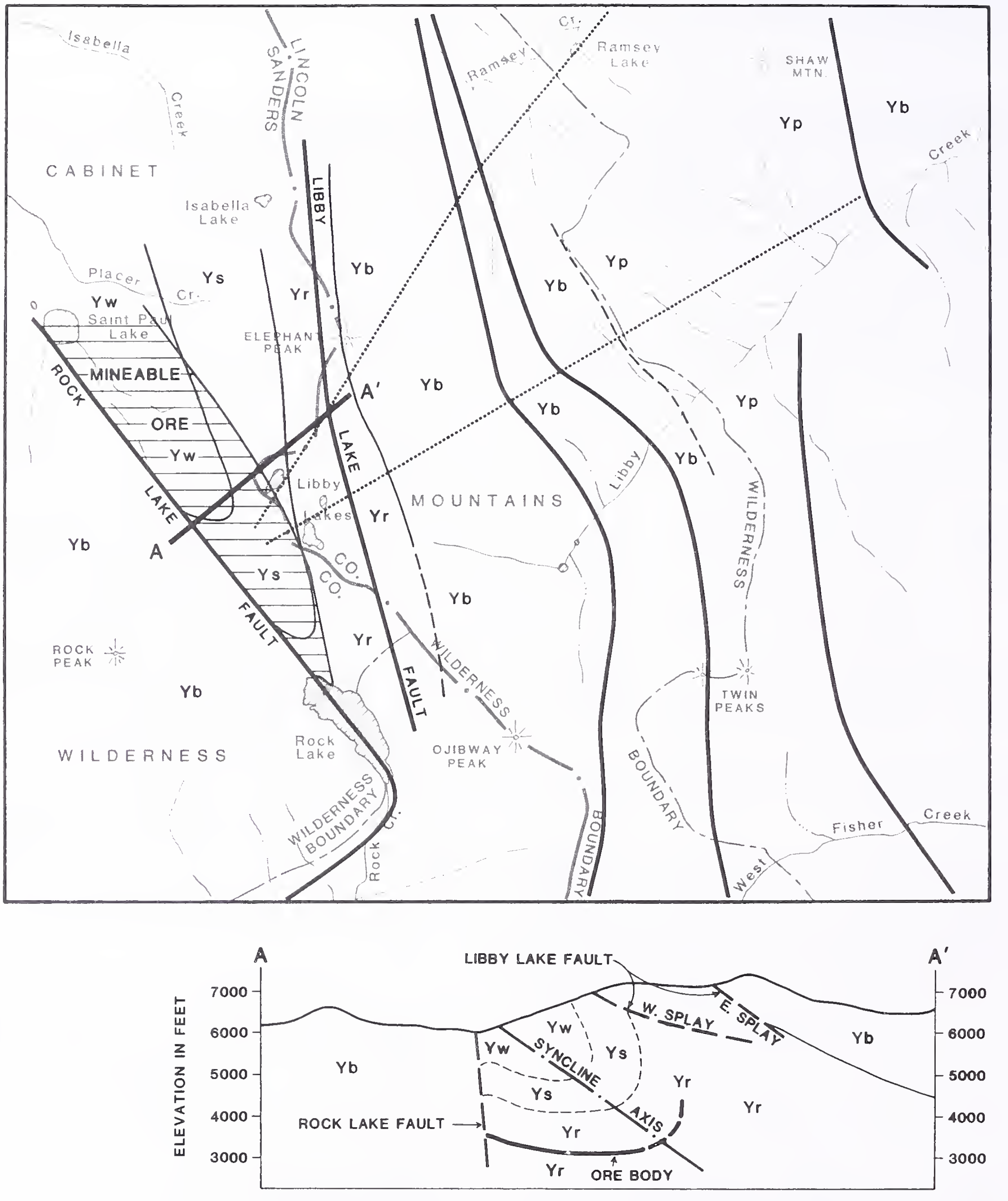
Noranda has identified two distinct subparallel ore zones, the B-1 (upper) and B (lower), averaging 30 feet and 34 feet, respectively. These ore zones average 1.93 ounces per ton of silver and 0.74 percent (14.8 pounds per ton) copper (Noranda Minerals Corp., 1991). The highest average grades encountered during drilling are 5.93 ounces per ton of silver and 1.13 percent copper. Current ore reserves are estimated at 135 million tons.

The silver/copper ore zones are separated by a low-grade lead zone (the barren zone) of disseminated and vein-related galena. The barren zone varies in thickness from more than 200 feet toward the west to 18 feet in the eastern portions of the mine area. The barren zone may be absent to the northeast. Sampling and analysis of the lead zone by Noranda and its predecessor, U.S. Borax and confirmed by the KNF indicates lead concentrations in the zone are not economically mineable at current market condition.

Geology of the Tailings Impoundment and LAD Areas

The geology of proposed tailings impoundment area consists of recent alluvium and colluvium, and Pleistocene lacustrine and glaciofluvial deposits overlying Precambrian bedrock (Figure 3-3). The geology of the Ramsey Creek LAD area is similar. Based on weathered bedrock outcrops in this area, bedrock is identified as the Wallace Formation. The Wallace formation is overlain by as much as 300 feet of unconsolidated deposits.

The glaciolacustrine deposits (lake bed deposits) resulted from glacial damming of the Kootenai River and Libby Creek drainages. Lake bed deposits of



CROSS SECTION A–A'

LEGEND

- Yw — Wallace Formation
- Ys — St. Regis Formation
- Yr — Revett Formation
- Yb — Burke Formation
- Yp — Prichard Formation
- Fault
- Contact (Dashed where inferred)
- A—A' Cross Section A–A'
- Mineable Ore
- Adit

Source: Noranda Minerals Corp. 1989a.

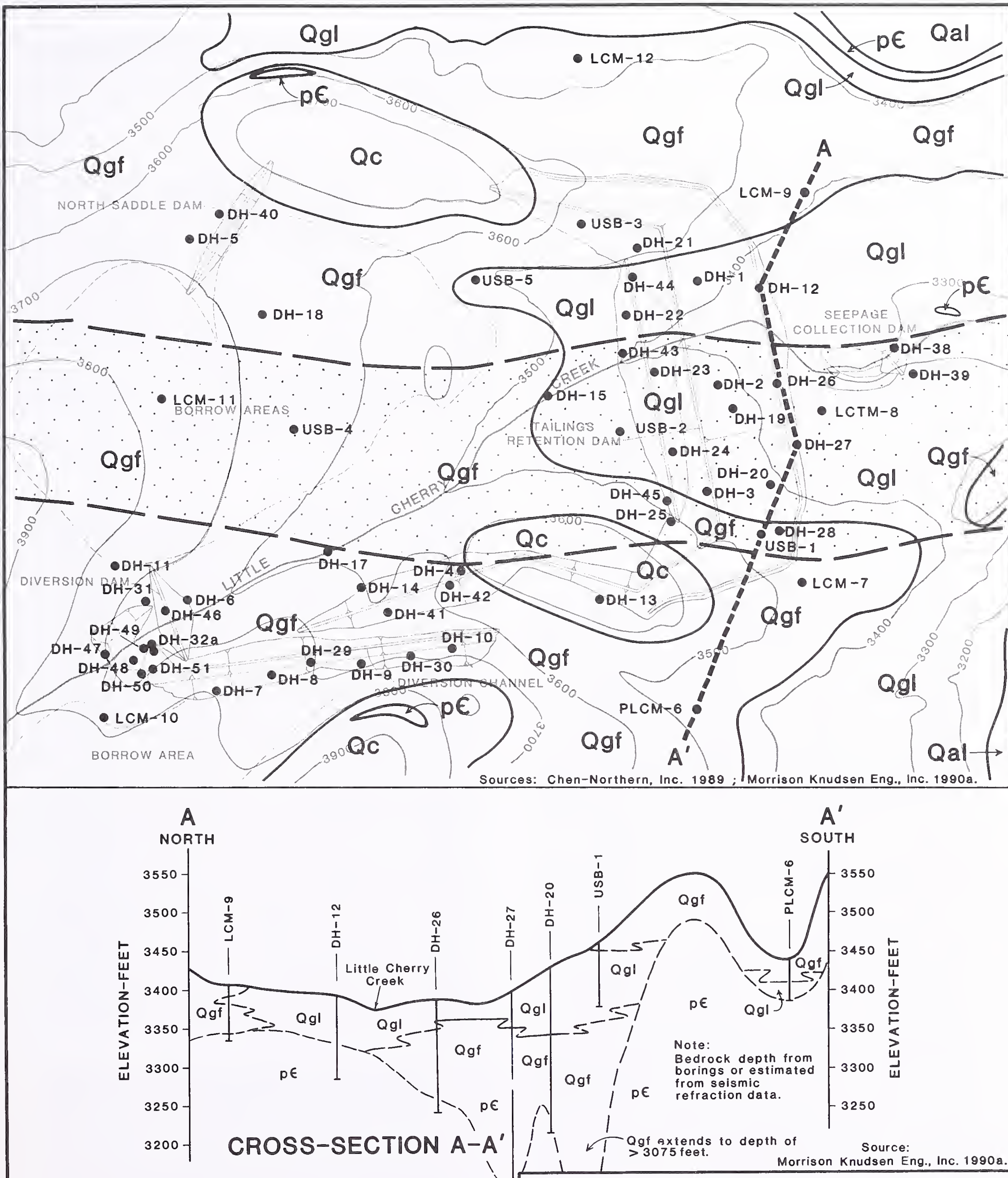
FIGURE 3-2.

GEOLOGIC MAP AND CROSS SECTION – MONTANORE PROJECT ORE BODY

NORTH

1000 0 2000

FEET



LEGEND

Qal	Alluvium
Qc	Colluvium
Qgl	Glaciolacustrine Deposits
Qgf	Glaciofluvial Deposits
pЄ	Precambrian Bedrock

Approximate Location of Buried Channel

Boring

Spring

NORTH

0 400 800

FEET

FIGURE 3-3.

GEOLOGIC MAP AND CROSS SECTION - TAILINGS IMPOUNDMENT AREA

silts and fine sand cover eastern portions of the tailings impoundment area (Figure 3-3). Glacio-fluvial deposits are intermixed silt, sand and gravel materials deposited by glacial meltwater streams. These unconsolidated deposits form an apron along the mountain front. The glaciolacustrine and glacio-fluvial deposits interfinger and overlap, and are not readily separated.

A buried, pre-glacial valley occurs in the proposed impoundment site (Figure 3-3). The channel underlies lacustrine deposits and is filled with over 275 feet of interbedded, poor to moderately-sorted, variably textured, stream-laid deposits. The buried valley has no surface expression.

Acid-base Potential

Certain naturally-occurring minerals, when disturbed by activities such as mining, may undergo a chemical weathering process (oxidation) and form acid. Other minerals in rocks have the ability to neutralize acid. For any given rock, the difference between the potential to produce acid and the potential to neutralize acid is the Net Neutralization Potential or acid-base potential. Noranda has conducted static geochemical tests of several rock types that would be encountered during mining operations. Acid-base potentials for Libby Creek adit waste rock are shown in Table 3-8. These include ore (Table 3-9), strata above and below the ore zone as well as the barren lead zone (Table 3-10). Average acid-base potentials for mine area rock are shown in Table 3-11. Acid-base information on tailings from the ASARCO Rock Creek permit application (ASARCO, Inc., 1987) is presented in Table 3-7. Because of similar ore lithologies and mineralogies, tailings from the Montanore Project should have similar acid-base potential as the Troy Mine tailings and as expected for the Rock Creek Mine tailings. An evaluation of acid rock drainage potential, based in part on this acid-base data, is presented in Chapter 4. An explanation of this acid-base data is included in that discussion.

Table 3-7. Acid-base potentials for Troy Mine and proposed Rock Creek Mine tailings.

Tailings source	Neutralization potential	Acid potential	Acid-base potential
Troy§	7.8	2.5	5.3
Rock Creek†	11	> -1	11

Source: ASARCO, Inc. 1987.
§Units in lbs. H_2SO_4 per dry ton material
†Units in tons $CaCO_3$ per dry ton material

Geologic Hazards

Potential geologic constraints in the project area were identified as part of the geological baseline studies. No landslides or unstable slopes were identified near the Ramsey Creek plant site, the Libby Creek portal site, or the tailings impoundment site. Slope failures, however, were noted where roads undercut hillsides in the North Fork of Miller Creek, and several slumps are occurring on the cut slopes. Fine-grained soils derived from lacustrine silts and clays also are susceptible to slope failures if undercut.

Several avalanche chutes occur in both upper Libby Creek and Ramsey Creek valleys (Figure 3-4). Over twenty snow chutes ranging in length from 1,000 feet to more than 5,000 feet were identified. Because of the high elevation of the chute tops and the narrow widths of the valleys below, avalanches can cross valleys and move up the opposite side. Similar hazards in the form of wet snow slide paths also occur in upper Libby Creek and Ramsey Creek valleys. These paths are typically very narrow and difficult to detect on aerial photographs.

The project area lies near the northern end of the Intermountain Seismic Belt, a north-south oriented zone of seismic activity which includes the Wasatch Mountain Front in Utah, the Teton-Yellowstone area in Wyoming, and parts of the Northern Rockies in western Montana. There is no record of moderate-

Table 3-8. Acid-base potentials for Libby Creek adit waste rock.

Location (feet inside adit)	Neutralization potential	Acid potential	Acid-base potential	Location (feet inside adit)	Neutralization potential	Acid potential	Acid-base potential
	—(tons $CaCO_3$/ ton dry material)—				—(tons $CaCO_3$/ ton dry material)—		
550	4	10	-6	1992	10	15	-5
580	22	15	+7	2729	32	35	-3
613	31	18	+13	3056	39	1	+38
628	7	11	-4	3685	37	8	+29
654	10	11	-1	4028	25	7	+18
665	17	9	+8	4507	43	0	+43
674	21	8	+13	4989	15	6	+9
694	15	5	+10	5453	16	6	+10
708	17	5	+12	5992	30	10	+20
725	26	5	+21	6483	14	15	-1
732	61	7	+54	6603	18	21	-3
748	28	16	+12	6669	38	0	+38
763	24	17	+7	6796	12	14	-2
779	19	18	+1	6897	16	18	-2
795	18	9	+9	6992	5	20	-15
819	21	5	+16	7107	12	30	-18
846	3	7	-4	7197	12	17	-5
848	33	5	+28	7298	39	20	+19
873	4	4	+0	7401	14	31	-17
874	10	6	+4	7499	15	19	-4
885	1	7	-6	7592	13	11	+2
895	6	6	+0	7699	28	18	+10
972	4	5	-1	7791	29	17	+12
986	1	6	-5	7897	28	14	+14
1000	6	5	+1	8003	17	19	-2
1040	22	7	+15	8100	22	8	+14
1055	19	6	+13	8200	27	11	+16
1136	24	3	+21	8299	20	19	+1
1145.5	26	11	+15	8401	33	12	+21
1211.5	22	2	+20	8497	29	11	+18
				8594	36	26	+10

Source: Noranda Minerals Corp. April 23, 1991—on file with the agencies.

Table 3-9. Acid-base potentials for Montanore Project ore.

Drill hole no.	Depth (feet)	Category	Lithology	Total sulfur (%)	Non-sulfate sulfur (%)	Neutralization potential (tons $CaCO_3$/ ton dry material)	Acid potential (tons $CaCO_3$/ ton dry material)	Acid-base potential (tons $CaCO_3$/ ton dry material)
HR-10	720-722	B zone	Quartzite	0.35	0.35	9	11	-2
HR-10	720-722	B zone	Quartzite	0.55	0.55	8	18	-10
HR-10D	720-722	B zone	Quartzite	0.55	0.55	6	17	-11
HR-11	992-994	B zone	Quartzite	0.39	0.39	7	12	-5
HR-12	1000-1002	B zone	Quartzite	0.34	0.34	1	10	-9
HR-12D	1000-1002	B zone	Quartzite	0.32	0.32	<1	10	-10
HR-13	1678-1680	B zone	Quartzite	0.38	0.36	7	12	-5
HR-14	1007-1009	B zone	Siltite	0.95	0.95	5	29	-24
HR-14D	1007-1009	B zone	Siltite	<.01	<.01	3	0	+3
HR-15	1696-1698	B zone	Quartzite	0.38	0.38	<1	12	-12
HR-15D	1696-1698	B zone	Quartzite	0.12	0.12	<1	4	-4
HR-16	2777-2779	B1 zone	Silty Quartzite	0.05	0.05	<1	2	-2
HR-16	2883-2885	B zone	Quartzite	0.28	0.28	10	9	+1
HR-17	1775-1777	B1 zone	Siltite	0.36	0.36	5	11	-6
HR-17	1846-1848	B zone	Siltite	0.54	0.54	18	17	+1
HR-17D	1846-1848	B zone	Siltite	0.54	0.54	18	17	+1
HR-18	1775-1777	B1 zone	Quartzite	0.17	0.17	8	6	+2
HR-18	1839-1841	B zone	Siltite/Silty Quartzite	0.15	0.15	7	5	+2
HR-19	2445-2447	B zone	Quartzite	0.01	0.01	4	0	+4
HR-19	2345-2347	B1 zone	Siltite	0.05	0.05	2	2	+0
HR-20	3242-3244	B zone	Siltite	0.49	0.49	3	15	-12
HR-21	2946-2948	B1 zone	Silty Quartzite	0.34	0.33	<1	10	-10
HR-22	2020-2022	B1 zone	Quartzite	0.05	0.05	<1	2	-2
HR-23	2266-2268	B zone	Quartzite	0.03	0.03	1	1	+0
HR-24	2924-2926	B1 zone	Quartzite	0.06	0.06	<1	2	-2
HR-24D	2924-2926	B1 zone	Quartzite	0.06	0.06	<1	2	-2
HR-24	3224-3226	B zone	Silty Quartzite	0.18	0.13	15	4	+11
HR-25	3334-3336	B zone	Silty Quartzite	0.07	0.07	3	3	+0
HR-25D	3334-3336	B zone	Silty Quartzite	0.20	0.20	16	6	+10
HR-26	3686-3688	B zone	Siltite	0.36	0.36	4	11	-7
HR-28	3537-3539	B zone	Siltite	0.18	0.18	<1	6	-6
HR-29	4468-4470	B zone	Siltite	0.37	0.37	<1	12	-12
HR-29	4387-4389	B1 zone	Siltite	0.46	0.46	<1	14	-14
HR-30	4266-4268	B zone	Silty Quartzite	0.40	0.40	<1	13	-13
HR-31	3551-3553	B zone	Silty Quartzite	0.15	0.15	<1	5	-5
Average								-4.3

Source: Noranda Minerals Corp. June 19, 1991—on file with the agencies.
D = Duplicate

Table 3-10. Acid-base potentials and total lead in mine area rock.

Drill hole no.	Category	Lithology	Neutralization potential (tons $CaCO_3$/ton dry material)	Acid potential (tons $CaCO_3$/ton dry material)	Acid-base potential (tons $CaCO_3$/ton dry material)	Total lead (ppm)
HR-10	HGPB	Quartzite	11	18	-7	16,100
	LGPB	Silty quartzite	20	8	+12	1,980
	FWB-5	Siltite	13	1	+12	7
HR-11	LGPB	Quartzite	27	31	-4	1,970
	FWB-5	Quartzite	3	3	+0	5
HR-14	HGPB	Siltite	13	7	+6	2,450
	FWB-5	Quartzite	2	2	+0	10
	FWB-20	Quartzite	4	<1	+3	20
HR-15	FWB-5	Quartzite	8	<1	+8	30
HR-16	HWB1-20	Quartzite	1	2	-1	7
	HWB1-5	Quartzite	4	2	+2	36
	HGPB	Silty quartzite	3	5	-2	14,600
	LGPB	Siltite	13	14	-1	1,340
	FWB-5	Siltite	9	<1	+9	14
HR-18	HWB1-20	Quartzite	2	2	+0	12
	HWB1-5	Silty quartzite	4	3	+1	7
	HGPB	Quartzite	8	2	+6	6,120
	LGPB	Quartzite	15	3	+12	1,790
	FWB-5	Quartzite	8	5	+3	17
	FWB-20	Quartzite	2	2	+1	5
HR-19	HWB1-20	Siltite	3	4	-1	91
	HWB1-5	Silty quartzite	4	2	+2	139
	HGPB	Siltite	6	3	+3	6,720
	LGPB	Siltite	15	4	+11	3,550
	FWB-5	Siltite	56	6	+50	19
HR-20	HWB1-20	Siltite	9	1	+8	5
	HWB1-5	Siltite	4	1	+3	12
	HGPB	Silty quartzite	5	5	+0	14,200
	LGPB	Siltite	19	23	-4	2,330
HR-21	HWB1-20	Siltite	11	1	+10	14
	HWB1-5	Silty quartzite	16	1	+15	5
	HGPB	Quartzite	2	3	-1	11,800
	LGPB	Silty quartzite	15	16	-1	2,620
	FWB-5	Siltite	3	5	-2	5
	FWB-20	Quartzite	6	<1	+6	1,670
HR-23	HGPB	Siltite	36	5	+31	2,060
	FWB-5	Quartzite	18	1	+17	12

Source: Noranda Minerals Corp. April 23, 1991—on file with the agencies.
Categories:
HWB1-20 = 20 feet above the hanging wall of the B1 zone
HWB1-5 = 5 feet above the hanging wall of the B1 zone
LGPB = Low grade lead zone
HGPB = High grade lead zone
FWB-5 = 5 feet below the foot wall of the B zone
FWB-20 = 20 feet below the foot wall of the B zone

Table 3-10. Acid-base potentials and total lead in mine area rock (cont'd).

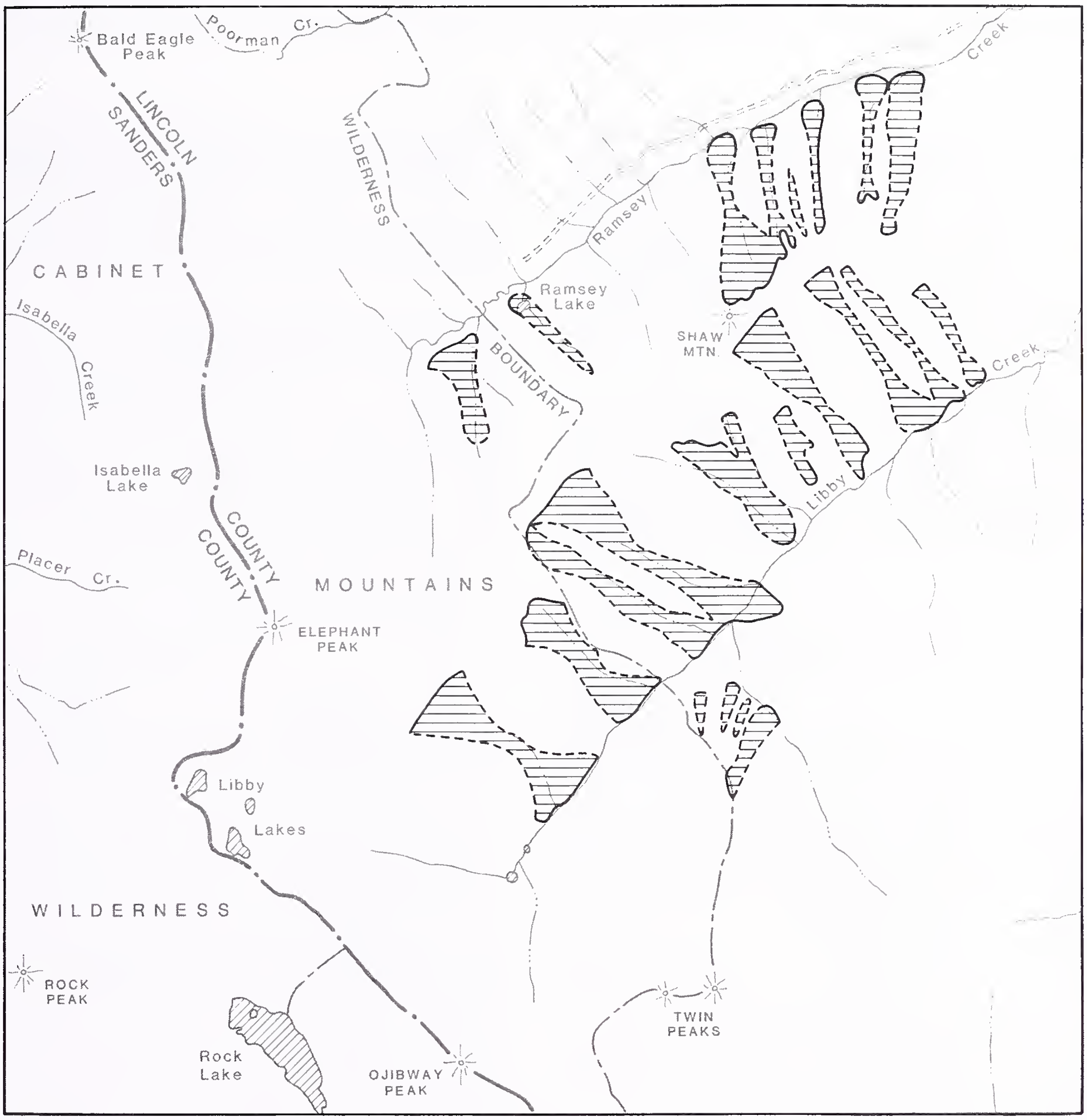
Drill hole no.	Category	Lithology	Neutralization potential (tons $CaCO_3$/ ton dry material)	Acid potential (tons $CaCO_3$/ ton dry material)	Acid-base potential (tons $CaCO_3$/ ton dry material)	Total lead (ppm)
HR-24	HWB1-20	Silty quartzite	4	1	+3	7
	HWB1-5	Quartzite	3	5	-2	65
	LGPB	Silty quartzite	6	4	+2	3,270
	HGPB	Quartzite	18	8	+10	9,260
	FWB-5	Siltite	6	<1	+6	24
HR-25	HWB1-20	Quartzite	4	3	-1	46
	HWB1-5	Quartzite	6	1	+5	17
	LGPB	Siltite	<1	<1	+0	2,090
	HGPB	Quartzite	19	4	+15	17,400
	FWB-5	Silty quartzite	4	<1	+4	17
	FWB-20	Silty quartzite	2	<1	+2	10
HR-29	HWB1-20	Silty quartzite	10	6	+4	542
	HWB1-5	Silty quartzite	1	2	-1	3,340
	LGPB	Quartzite	3	2	+1	2,200
	HGPB	Quartzite	3	9	-6	17,700
	FWB-5	Silty quartzite	12	2	+10	3
	FWB-20	Quartzite	1	2	-1	3
HR-30	HWB1-20	Silty quartzite	1	14	-13	1,100
	HWB1-5	Siltite	27	2	+25	5,790
	HGPB	Silty quartzite	3	9	-6	11,900
	LGPB	Silty quartzite	11	<1	+10	3,670
	FWB-5	Quartzite	4	3	-1	7
	FWB-20	Silty quartzite	1	5	-4	3

Source: Noranda Minerals Corp. April 23, 1991—on file with the agencies.

Table 3-11. Average acid-base potentials for mine area rock.

	Quartzite		Silty quartzite		Siltite		All samples	
Category	Acid-base potential	No. of samples	Acid-base potential	No. of samples	Acid-base potential	No. of samples	Acid-base potential	No. of samples
HWB1-20	+6	3	-2	3	+0	4	+1	10
HWB1-5	+14	2	+5	4	+2	4	+5	10
HGPB	+9	4	-3	3	+3	6	+4	13
LGPB	+2	5	+6	4	+3	3	+4	12
FWB-5	+15	5	+7	2	+4	7	+8	14
FWB-20	—	0	-1	2	+3	5	+2	7
Average	+9	19	+2	18	+3	29	+4	66

Source: Noranda Minerals Corp. April 23, 1991—on file with the agencies.
Categories:
HWB1-20 = 20 feet above the hanging wall of the B1 zone
HWB1-5 = 5 feet above the hanging wall of the B1 zone
LGPB = Low grade lead zone
HGPB = High grade lead zone
FWB-5 = 5 feet below the foot wall of the B zone
FWB-20 = 20 feet below the foot wall of the B zone



Source: Morrison-Knudsen Engineers, Inc. 1989b; IMS Inc. 1990

LEGEND

Avalanche Chute

FIGURE 3-4.

AVALANCHE CHUTES IN LIBBY AND RAMSEY CREEK DRAINAGES

NORTH

1000 0 2000

FEET

to-large earthquakes locally. The two largest earthquakes, the Hebgen Lake (Montana) earthquake in 1959 and the Borah Peak (Idaho) earthquake in 1983, were both about 300 miles from the project area. They caused no significant effects on the Libby area. Smaller earthquakes have occurred in the Idaho panhandle in the vicinity of Lake Pend d'Oreille, and between Libby and Kalispell (Table 3-12).

The frequency of smaller events and the presence of long faults of undetermined seismic activity indicate that a large earthquake is possible in the project area. The Maximum Credible Earthquake was estimated for several potentially active earthquake sources—the Bull Lake or Rainey Creek faults, the Flathead Lake Seismic Zone, and a random local earthquake. The estimated Maximum Credible Earthquake from these sources ranges from 6.5 to 7.3 in magnitude on the Richter scale.

Other Geologic Resources

The project area is located in a region rich in mineralization. Historically, silver, lead, zinc, and gold have been produced from numerous mines and placer operations. Two abandoned prospects occur above the Montanore Project ore body near St. Paul Pass. Other mining prospects are known near the

Table 3-12. Significant earthquakes in the region.

Date	Location	Magnitude (Richter scale)	Maximum intensity§	Distance from project area (miles)
2-25-71	S.E. of Libby, MT	—	IV	14
6-26-64	Marion, MT	4.7	IV	21
3-12-18	Lake Pend d'Oreille, ID	—	IV	27
4-15-52	Whitepine, MT	—	IV	30
8-16-60	Sandpoint, ID	—	IV	47
7-10-30	Missoula, MT	—	V	48
12-19-57	Wallace, ID	5.0	VI	48
11-28-26	Wallace, ID	—	V	48
5-9-44	Wallace, ID	—	IV	48
6-8-54	Wallace, ID	—	V	50
9-23-61	Wallace, ID	—	IV	51
11-01-42	WA/ID border	—	VI	52
9-23-45	Flathead Lake, MT	5.5	VII	65
2-4-75	Creston/Kalispell, MT‡	4.6	VI	66
3-31-52	Big Fork, MT	5.5	VII	70
7-31-69 to 10-30-70	Canada (9 events)	5.0 to 5.3	VI	116 to 128
12-20-72	Canada	5.1	VI	116
7-16-36	Milton-Freewater, OR	5.75	VII	205
8-17-59	Hebgen Lake, MT	7.5	X, V†	293
10-28-83	Borah Peak, ID	7.3	IX, V†	310

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-86.
§Epicentral Modified Mercalli Intensity
‡Representative event; numerous other earthquakes with magnitudes less than 5 have occurred near Flathead Lake.
†Reported local intensity at Libby, Montana

head of Miller Creek. More recently, several significant copper-silver deposits have been discovered.

Mining activity began in the project area around 1882 when placer gold was mined on Libby Creek near the confluence with Poorman Creek (Johns, 1970). Placer mining occurred throughout the Libby Creek watershed and included operations in Poorman Creek, Ramsey Creek, upper Libby Creek, and near the confluence of Little Cherry Creek and Libby Creek. Most placer mining took place during the 30 years following initial discovery. Some placer mining has occurred intermittently since and continues, although it is now primarily recreational. A recreational gold panning area has been developed by the KNF one mile north of Howard Lake on Libby and Howard creeks.

At higher elevations in the Cabinet Mountain Range, numerous operations mined the mineralized zones associated with the Snowshoe and Rock Lake faults. Lead, zinc, silver, copper and some gold mineralization occurs at rock outcrops along the Snowshoe Fault. The majority of this mining was along the fault zone between Flower and Lake creeks, where the Snowshoe Mine was the largest producer. Several historic mining operations were also associated with the Rock Lake Fault, where gold was found in association with sulfide mineralization. The Heidelberg Mine, which began operations in the 1920s, has the only production recorded from this fault zone (Banister et al., 1981).

Stratiform copper occurrences are widespread in the Precambrian Belt Supergroup rocks, with the most significant deposits occurring in the Revett Formation quartzites. ASARCO's existing Troy mine is located in this type of mineral deposit. The proposed Montanore Project and ASARCO's proposed Rock Creek Project would also mine ore from this type of deposit.

HYDROLOGY

Mining would occur beneath the divide separating the Rock Creek and Libby Creek drainages. The mine area is drained on the east by Libby Creek and its tributaries—Ramsey Creek, Poorman Creek, and Little Cherry Creek (Figure 3-5). Libby Creek flows northward from the project area about 28 miles to its confluence with the Kootenai River at the town of Libby. Rock Creek flows southwest into the Clark Fork River downstream of Noxon Reservoir.

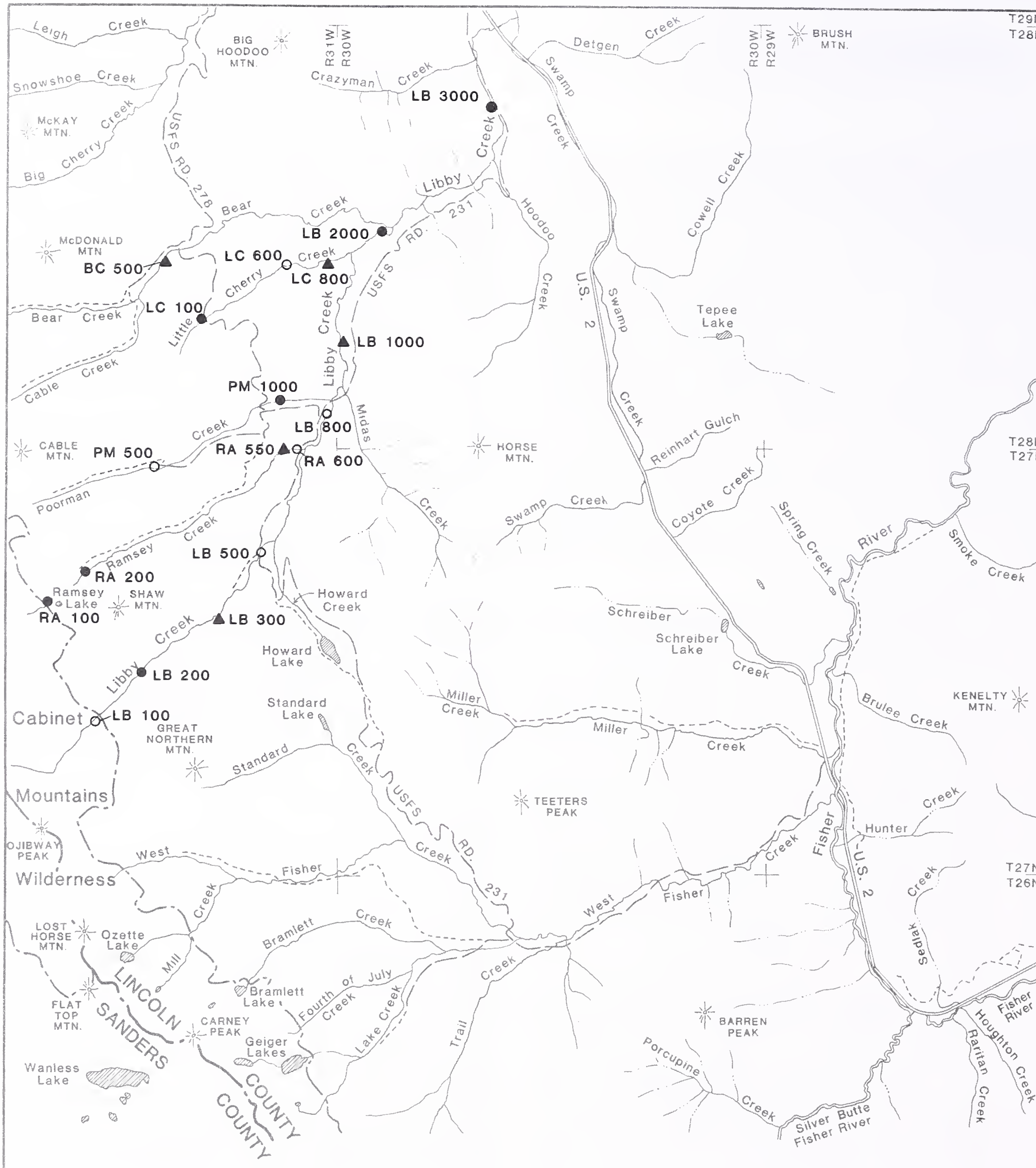
The transmission line corridor area is drained by tributaries of the Kootenai River—the Fisher River, Miller Creek, West Fisher Creek, Brulee Creek, Schrieber Creek, Swamp Creek, Fourth of July Creek, Ramsey Creek, Libby Creek, Trail Creek, and Standard Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the project area (Figure 3-5). In addition, several lakes and swampy areas also can be found in the project area. One-hundred-year floodplains have been designated along the Fisher River, Miller Creek, North Fork of Miller Creek, Ramsey Creek, and Libby Creek.

Surface Water

Snowmelt is the main source of surface water. High surface water flows typically occur during spring snowmelt, and during winter months when warm conditions combined with precipitation produce both snowmelt and runoff. Surface water conditions of mine area streams are described in the following sections.

Libby Creek. Libby Creek headwaters are in a steep glacial cirque basin at the crest of the Cabinet Mountains. The upper reaches of Libby Creek are intermittent and are restricted to a narrow canyon channel flowing across bedrock or coarse valley-fill and glacial deposits.

The Libby Creek valley widens downstream where more erodible alluvial, lacustrine, and glaciofluvial deposits are encountered. In these lower reaches,



Source: Noranda Minerals Corp. 1989a.

LEGEND

SURFACE WATER SAMPLING SITES:

● 1988 Baseline and 1992 Interim Periods

○ 1988 Baseline Period

▲ 1992 Interim Monitoring Period

FIGURE 3-5.

SURFACE WATER SYSTEM OF THE PROJECT AREA

Libby Creek is perennial with flow sustained by ground water discharge. Libby Creek is the only stream in the mine area that has a well developed flood plain.

Measured flow during the baseline and interim monitoring periods in Libby Creek ranges from 1.1 to 51 cubic feet per second (cfs) at the uppermost station above the Libby Creek adit (LB 200), and from 10.6 to 748 cfs at the most downstream station (LB 3000) (Table 3-13). Estimated flood flow at LB 800 ranges from about 950 to 2,500 cfs for a 100-year event (Table 3-13).

Ramsey Creek. Ramsey Creek drains 6.5 square miles of watershed as it flows 5.3 miles to Libby Creek. The upper watershed is poorly drained and contains both a marshy area and Ramsey Lake, a small lake (Figure 3-5). Water in the marsh flows through a series of ponds and meanders through grassy, wet meadows. Downstream of the meadows, the channel becomes similar to Libby Creek.

Ramsey Creek is a perennial stream with heavily forested banks having an average streamflow of between 19 and 32 cfs (Table 3-13). The estimated 100-year flood ranges from 325 cfs to about 1,200 cfs near the proposed plant site.

Poorman Creek. Poorman Creek is a small, perennial stream located south of the tailings impoundment area. It has a drainage area of about 6.1 square miles and flows about 5.3 miles from its

Table 3-13. Measured flow and flood flow estimates in Libby Creek (in cfs).

Drainage	Station†	Period of sampling	Stream discharge Mean	Minimum	Maximum§	Peak flood estimates 25 Year	50 Year	100 Year
Libby Creek	LB-100	4/88 to 10/88	27.7	1.1	51	—	—	—
	LB-200	4/88 to 11/91	34.9	1.2	113	312-439	355-772	416-1,325
	LB-300	9/89 to 11/91	36.1	2.0	100	—	—	—
	LB-500	4/88 to 9/89	40.3	1.0	174	—	—	—
	LB-800	4/88 to 9/90	79	2.9	250	740-1,060	827-1,653	947-2,517
	LB-1000	4/91 to 8/91	65	22.4	108	—	—	—
	LB-2000	4/88 to 8/91	106	5.8	204	—	—	—
	LB-3000	4/88 to 8/91	167	10.6	748	1,487-2,167	1,637-3,571	1,840-5,692
Ramsey Creek	RA 100	4/88 to 8/91	19.3	0.3	61	—	—	—
	RA 200	4/88 to 8/91	24.0	1.1	63	240-309	275-607	325-1,163
	RA 500	4/91 to 8/91	25.8	8.7	37.9	—	—	—
	RA 600	4/88 to 9/90	32.0	1.4	120	—	—	—
Poorman Creek	PM-500	4/88 to 8/89	19.2	0.5	85	—	—	—
	PM-1000	4/88 to 8/91	23.1	0.7	91	324-444	368-778	431-1,331
Little Cherry Creek	LC 100	4/88 to 8/91	2.2	0.1	11.8	—	—	—
	LC 600	4/88 to 2/91	3.3	0.2	13.2	53-234	64-502	78-1,049
	LC 800	4/91 to 8/91	4.2	0.2	9.7	—	—	—
Bear Creek	BC-100	4/88 to 10/88	38.1	1.8	98	476-859	538-1,319	622-1,918
	BC 500	4/91 to 8/91	59	8.5	101	—	—	—

Source: Chen-Northern, Inc. 1989, 1990, 1991a, 1992a.
†See Figure 3-5 for station locations.
§Maximum flow not measured due to high water conditions at some locations; maximum measured flow shown.
— = flood flows not estimated

headwaters to its confluence with Libby Creek. Poorman Creek flows in a narrow, straight channel with heavily forested banks and a boulder, cobble, and gravel bed. Streamflow in Poorman Creek ranges seasonally from 0.5 to 91 cfs (Table 3-13). Streamflow is relatively constant both upstream and downstream. The estimated 100-year flood ranges from about 400 to 1,300 cfs.

Little Cherry Creek. Little Cherry Creek is a perennial stream originating on the lower slopes of the Cabinet Mountains. It drains approximately 1.9 square miles, and flows 2.8 miles to its confluence with Libby Creek. Streambed material ranges from boulders to sand and silt. The upper portion of the watershed is forested and the lower portion has been logged. In logged areas, stream banks are collapsed, and small shrubs and forbs have become established.

Streamflow during baseline and interim monitoring ranged seasonally from 0.1 to 12 cfs at the upstream station, and from 0.2 to 10 cfs at the downstream station in the tailings impoundment area (Table 3-13). Streamflows are generally low (~3.0 cfs), and remain relatively constant between the upstream and downstream stations. Estimated flood flows in Little Cherry Creek range from 78 cfs to over 1,000 cfs for the 100-year event.

Bear Creek. Bear Creek is the largest tributary of Libby Creek in the project area, draining a 15-square mile area. Originating in a glacial basin at an elevation of about 7,100 feet, Bear Creek flows 8.5 miles, converging with Libby Creek at an elevation of 3,050 feet. Most of the stream bed is heavily forested. The streambed material is primarily cobbles and gravels.

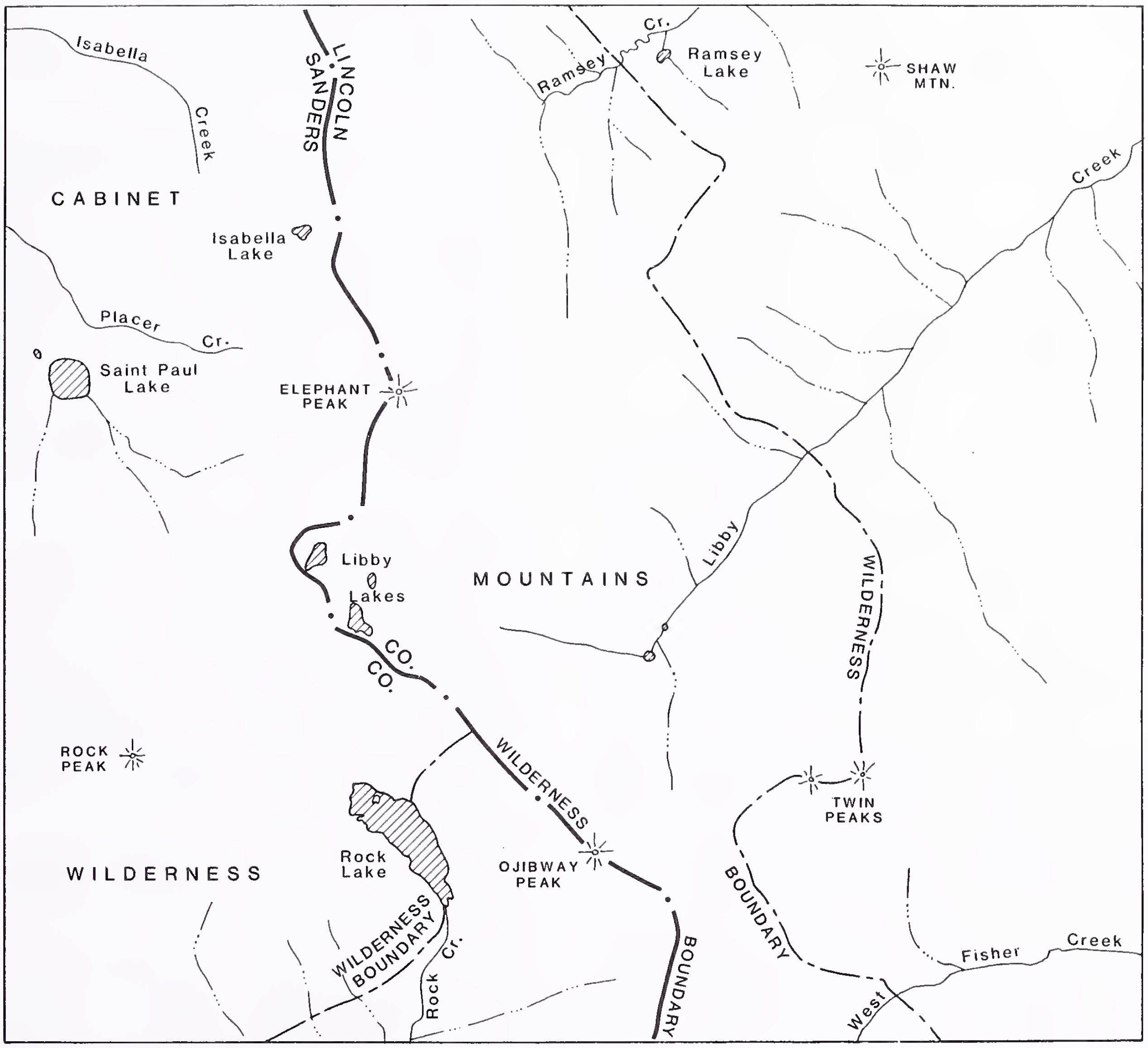
Streamflow measured at the one monitoring station in Bear Creek ranged from 1.8 cfs during the early fall (September) to a high of 101 cfs during the spring runoff in May. Estimated 100- year flood flows in Bear Creek range from 622 cfs to over 1,900 cfs.

Mountain lakes. Several alpine lakes occur in the project area (Figure 3-6). Many of these lakes are located in glacial cirques that act as collection basins for runoff and snowmelt. Rock Lake and St. Paul Lake are located along the Rock Lake Fault. Rock Lake is the headwaters source for East Fork of Rock Creek.

St. Paul Lake is the headwaters source for the East Fork of Bull River. Runoff from a small headwaters watershed (1.5 square miles) flows into St. Paul Lake. The lake is dammed by glacial morainal material, and outflow from the lake is through morainal gravels to a small pond located a few hundred feet downstream. Discharges from the pond flow to an unnamed tributary to the East Fork of Bull River. Other lakes, such as Libby Lakes and Isabella Lake, are smaller, and lie within closed depressions along the crest of the Cabinet Mountains.

Water Use

Surface water in the project area is put to a variety of beneficial uses including domestic water supply, irrigation, mining, stock watering, fish habitat, and wildlife. The DNRC conducted a file search to determine existing surface and ground water diversions along Libby Creek from the mine area to the confluence with the Kootenai River. Sixty-four water rights are on record with the DNRC for surface water, including the use of springs, and diversions along Bear, Little Cherry, Poorman, Ramsey and Libby creeks. Of these 64 rights, 19 are in the actual project area (upstream of the confluence of Swamp and Libby creeks; near the Libby Creek campground). Noranda holds 4 of the 19 rights in the project area; three temporary rights for exploratory drilling and one temporary right for dust control. Most of the recorded surface water permits are for domestic, irrigation, and mining or industrial use. All but two of the 277 ground water rights identified in DNRC's search are downstream of the project area (upstream of the confluence of Swamp and Libby creeks; near the Libby Creek campground). One of the ground water rights in the project area is held by Noranda.



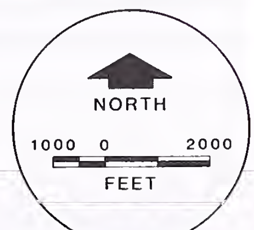


FIGURE 3-6.

MOUNTAIN
LAKES IN
PROJECT AREA

Surface Water Quality

The Kootenai River basin includes some of the purest waters in America; concentrations of dissolved chemicals are among the lowest in Montana (DHES, undated). Streams in the project area are classified by the DHES as B-1 streams, which are suitable for drinking, culinary, and food preparation purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life; waterfowl and furbearers; and agricultural and industrial uses. Streams in the wilderness are classified as A-1 streams, a higher water quality classification.

Mine area streams. Surface water quality during the baseline monitoring period of the mine area streams is summarized in Table 3-14. Except for nitrate concentrations, surface water quality during interim monitoring was similar to baseline conditions. Surface waters are a mixed-cation bicarbonate-type water. Total suspended solids, total dissolved solids, major ions, and nutrient concentrations were all very low, frequently at or below analytical detection limits. Field pH measurements ranged from 6.3 to 7.2. Total suspended solids averaged less than 3 mg/L; average total dissolved solids were less than 31 mg/L. Major ion concentrations were generally too low to identify a dominant cation.

Generally, total dissolved solids concentrations, major ion concentrations, and some minor ions such as iron increased downstream in Libby Creek and its tributaries (Table 3-14). The highest average total dissolved solids concentrations were found at the downstream station in Little Cherry Creek.

Metal concentrations were also generally low. Aluminum, arsenic, chromium, manganese, molybdenum, and zinc concentrations were consistently below detection limits. Low concentrations of iron, copper and silver were found at most sampling stations. The presence of copper and silver is probably related to local mineralization. Mercury was found at or below detection limit concentrations at all sampling locations. Cadmium in all surface water samples resulted from sample contamination; analytical results do not reflect baseline conditions. Sample contamination was resolved in subsequent interim monitoring (Chen-Northern, Inc., 1990, 1991a, 1992a).

Seasonal variation occurs in surface water quality. Nutrient concentrations (nitrate and nitrite as N, total phosphorous, and orthophosphate) increased during spring runoff. Total dissolved solids decreased during spring runoff and increased during low flow periods, while total suspended solids increased slightly during spring runoff. Concentrations of certain metals, such as silver and copper, occurred at their highest during spring runoff and declined to at or below detection limits during low flow conditions.

Kootenai River. The U.S. Geological Survey (USGS) maintains two water monitoring stations on the Kootenai River near Libby, Montana. One station is located 0.7 miles downstream from Libby Dam and 11 miles east of Libby. The second station is located 0.8 miles downstream of the Libby Creek confluence. Stream flow is measured at both monitoring stations, and surface-water quality is monitored at the upstream station below Libby Dam.

Flow data for these monitoring stations are averaged for water years 1987 through 1991 (Table 3-15). Average daily discharge for each water year varies from 9,144 to 9,646 cubic feet per second (cfs) at the station below Libby Dam and from 9,945 to 10,330 cfs at the station below Libby Creek. High monthly average flows and maximum instantaneous discharge occurred from September to December, and low flows occurred from March to August during these water years. Both monitoring stations are located downstream of Libby Dam and Lake Koocanusa where flow in the Kootenai River is regulated.

Table 3-14. Surface water quality data—Libby Creek and tributaries (baseline year).§

Parameter Station No.†—>	Libby Creek: Above adit (LB 100)	Above adit (LB 200)	Above Howard Creek (LB 500)	Above Ramsey Creek (LB 800)	Above Lt. Cherry Creek (LB 2000)	Down-stream of mine area (LB 3000)
Specific conductance (µmhos/cm)	9.7	11.9	14.6	26.2	30.4	53.3
pH (standard units)	6.9	6.7	6.7	7.1	7.1	7.2
Temperature (°C)	6.5	6.2	5.7	6.4	10.4	7.0
Total Phosphorus (mg/L)	0.005	0.007	0.007	0.018	0.006	0.006
Orthophosphate (mg/L)	<0.005	0.007	0.005	0.005	0.006	0.006
Nitrate/Nitrite Nitrogen (mg/L)	0.12	0.13	0.09	0.07	0.06	0.09
Ammonia (mg/L)	0.08	0.08	0.07	0.07	<0.08	0.07
Total Kjeldahl Nitrogen (mg/L)	<0.20	0.20	<0.20	<0.20	<0.20	0.20
Total suspended solids (mg/L)	1.8	1.6	1.3	1.7	1.6	1.9
Total dissolved solids (mg/L)	9.4	11.0	15.6	16.9	20.0	29.0
Turbidity (NTU)	0.42	0.38	0.3	0.43	0.51	0.90
Oil & Grease (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	1.6
Major cations (mg/L)						
Calcium	1.0	1.0	1.0	1.0	3.2	5.4
Magnesium	<1.0	<1.0	<1.0	<1.0	1.1	1.4
Sodium	1.3	1.1	1.8	1.8	1.4	1.3
Potassium	1.2	1.3	1.3	1.3	1.7	1.3
Major anions (mg/L)						
Bicarbonate (as HCO_3)	5.8	6.1	8.1	13.1	20.8	29.8
Chloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate	1.6	1.4	2.1	1.3	1.4	1.8
Total Hardness (as $CaCO_3$)	<5.7	<5.7	<5.8	5.6	9.8	17.5
Total Alkalinity (as $CaCO_3$)	4.8	5.1	6.5	10.7	17.2	23.9
Fluoride	0.06	0.06	0.05	0.06	<0.05	0.06
Total recoverable metals (mg/L)						
Aluminum	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0012	0.0018	0.002	0.0007	0.0004	0.002
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.001	0.002	0.002	0.002	0.002	0.002
Iron	<0.05	<0.05	0.05	0.05	0.05	0.08
Lead	<0.001	<0.001	<0.001	0.001	<0.001	0.001
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.0002	<0.0003	0.0003	0.0002	0.0003	0.0003
Zinc	0.02	0.02	<0.02	<0.02	<0.02	0.02

Source: Chen-Northern, Inc. 1989. Appendix G.
§Average values for baseline year in mg/L; some averages include values less than the analytical detection limit.
†See Figure 3-5 for station locations.

Table 3-14. Surface water quality data—Libby Creek and tributaries (baseline year) (con't).§

Parameter Station No.†—>	Ramsey Creek at mouth (RA 600)	Little Cherry Creek (LC 600)	Bear Creek (BC-100)
Specific conductance (µmhos/cm)	17.2	46.7	72.4
pH (standard units)	6.7	7.1	7.5
Temperature (°C)	5.7	6.8	8.8
Total Phosphorus (mg/L)	0.035	0.008	0.006
Orthophosphate (mg/L)	0.013	0.007	0.006
Nitrate/Nitrite Nitrogen (mg/L)	0.066	0.3	0.194
Ammonia (mg/L)	0.07	0.07	<0.08
Total Kjeldahl Nitrogen (mg/L)	0.29	0.20	<0.20
Total Hardness (as $CaCO_3$)	<5.8	12.5	30.2
Total Alkalinity (as $CaCO_3$)	6.2	19.9	37.3
Fluoride	0.06	0.06	0.06
Total suspended solids (mg/L)	1.4	2.5	1.4
Total dissolved solids (mg/L)	10.6	30.6	40.9
Turbidity (NTU)	0.35	1.35	0.37
Oil & Grease (mg/L)	<1.0	<1.0	<1.0
Major cations (mg/L)			
Calcium	1.0	3.4	10.2
Magnesium	<1.0	1.2	1.5
Sodium	1.7	2.1	1.1
Potassium	1.2	1.4	1.2
Major anions (mg/L)			
Bicarbonate (as HCO_3)	7.4	25.1	45.6
Chloride	<1.0	<1.0	<1.0
Sulfate	2.2	1.6	1.5
Total recoverable metals (mg/L)			
Aluminum	<0.10	0.12	<0.10
Arsenic	<0.005	<0.005	<0.005
Cadmium	0.002	0.003	0.002
Chromium	<0.02	<0.02	<0.02
Copper	0.002	0.002	0.002
Iron	0.05	0.08	0.05
Lead	0.001	0.001	<0.001
Manganese	<0.02	<0.02	<0.02
Mercury	0.0002	0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05
Silver	0.0003	0.0003	0.0003
Zinc	0.02	<0.02	<0.02

Source: Chen-Northern, Inc. 1989. Appendix G.
§Average values in mg/L; some averages include values less than the analytical detection limit.
†See Figure 3-5 for station locations.

Table 3-15. Kootenai River flow information.

	Below Libby Dam	Below Libby Creek
Five year averages (1987 to 1991)		
Mean daily discharge	11,300	12,100
High monthly mean discharge	23,200	22,100
Low monthly mean discharge	3,330	4,300
Maximum discharge §	22,000	27,900
Minimum discharge ¶	3,270	3,800

Source: U.S. Geological Survey, 1987-1991.
Discharge values presented in cubic feet per second (cfs)
§ Instantaneous discharge
¶Daily discharge

The main stem of the Kootenai River is classified as a B-1 stream, according to state regulations. Streams classified as B-1 are suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salminoid fishes and associated aquatic life, waterfowl and fur bearers; and agricultural and industrial water supply. The results of USGS monitoring (Table 3-16) show that surface water quality is good, although dissolved solids, total alkalinity, and total hardness concentrations are higher than concentrations observed in the project area streams. Nitrogen compounds (ammonia, nitrate and nitrite), arsenic, and lead were identified in several samples at concentrations at or near analytical detection limits, but were not detected in other samples. Iron, manganese and zinc were identified at concentrations above the detection limit. These concentrations, however, are below secondary drinking water standards.

Ground Water

Ground water investigations conducted by Noranda were limited to the mine area. Ground water in the transmission line corridor area would not be affected by the project.

Three hydrogeologic systems govern the amount, distribution, and flow of ground water in the mine area. They are—

Table 3-16. Kootenai River water quality and flow, 1987 to 1989.

	Water Year					
	1987		1988		1989	
Parameter	April	August	April	August	April	August
Discharge† (cfs)	3,060	12,000	2,990	3,040	3,020	23,500
Dissolved solids§	160	130	168	125	149	116
Total hardness	140	110	150	110	140	110
Total alkalinity¶	123	103	126	96	112	92
Total ammonia•	0.40	0.20	0.20	.40	<0.20	<0.20
Nitrate and nitrite	0.100	<0.100	0.130	0.100	<0.100	<0.100
Arsenic, total	<0.001	0.001	0.002	0.003	<0.001	0.001
Iron, total recoverable	0.070	0.020	0.050	0.030	0.070	0.020
Lead, total recoverable	<0.005	<0.005	<0.005	<0.005	<0.005	0.002
Manganese, total recoverable	0.010	0.010	0.020	<0.010	0.010	<0.010
Zinc, total recoverable	0.020	<0.010	<0.010	0.010	0.050	0.070

Source: USGS, 1987; 1988; and 1989. (units in mg/L except where noted)
†Instantaneous discharge §Sum of constituents
¶Laboratory analysis •Nitrogen, ammonia plus organic

- bedrock ground water systems;
- valley-fill ground water systems in narrow mountain valleys; and
- a glaciofluvial/lacustrine ground water system along the eastern flank of the Cabinet Mountains.

Bedrock ground water. Bedrock in the mine area generally has low primary porosity and permeability. Unfractured metasedimentary deposits (quartzite and siltite) normally have hydraulic conductivities (a coefficient describing the rate at which water can move through a permeable material under standard conditions) ranging from 10^{-7} to 10^{-11} centimeters per second (cm/sec.), and cannot store or transmit ground water. Ground water primarily occurs in fractures (joints or faults) in the bedrock. The bedrock in the mine area is generally highly fractured. In addition to major fractures such as the Rock Lake Fault and the Snowshoe Fault, three joint sets have been identified. Fractured bedrock has hydraulic conductivities ranging from 10^{-4} to 10^{-6} cm/sec.

Bedrock ground water is recharged by infiltration of precipitation and snowmelt and by seepage from high mountain streams. The ground water systems are unconfined, and water levels within the fractured bedrock define a water table. The ground water tables generally parallel surface topography. Ground water flows along fracture trends (north-northwest and east-northeast) toward topographic lows, discharging to high mountain lakes, springs, streams and unconsolidated valley-fill deposits.

Bedrock ground water tables are expressed in lake levels, springs, and in water levels observed during drilling. Ground water encountered at drill sites near Rock Lake and St. Paul Lake indicate static water levels approximating those of nearby lakes. Drilling at other sites encountered deeper static water levels or encountered no static water level at all. The high degree of variability exhibited by the borehole records reflects the complexity and lack of horizontal or vertical interconnection in the fracture systems.

Valley-fill ground water. Ground water systems in the valley-fill deposits in narrow mountain valleys are limited. These deposits contain colluvial, alluvial, and glacial materials in a heterogeneous mixture of clay, silt, sand, and larger-sized particles.

Valley-fill deposits follow the valley bottoms and are not extensive or continuous—in some places, bedrock outcrops along the stream channel bottoms. Geophysical surveys indicate the valley-fill deposits to be 30 to 70 feet deep at the Libby Creek adit site, and 24 to 70 feet deep at the plant site. Ground water was encountered during drilling at depths of 12 to 16 feet at the Libby Creek site and at 22 feet at the Ramsey Creek site.

The valley-fill systems are recharged by precipitation and snowmelt, by stream flow, and by discharge from bedrock ground water systems. Ground water flow is down-valley. The systems discharge to surface water or to more extensive glaciofluvial-lacustrine deposits along the mountain front.

Glaciofluvial/lacustrine ground water. In the tailings impoundment area and Ramsey Creek LAD area, ground water occurs as perched water and under artesian conditions in unconsolidated glaciofluvial and lacustrine deposits. These glacial deposits form a wedge along the eastern flank of the Cabinet Mountains, beginning at an elevation of about 4,000 feet and increasing in depth away from the mountains. These deposits range in thickness from zero at bedrock outcrops near the Little Cherry Creek impoundment site to over 200 feet in the Poorman Creek area.

The glaciofluvial and lacustrine deposits are interfingered, and, at many locations, lacustrine deposits overlie glaciofluvial deposits. The lacustrine deposits are finer grained and act as a barrier to ground water flow. In the Little Cherry Creek area, a buried pre-glacial valley underlies the lacustrine deposits. This valley has been abandoned and is filled with over 275 feet of fluvial sediments similar to the glaciofluvial deposits.

The glaciofluvial/lacustrine ground water system is recharged by precipitation, snowmelt, and streamflow along the flank of the mountains. Ground water flow in the impoundment area is generally easterly following the surface topography (Figure 3-7; shown for the baseline year). The potentiometric surface gradient is low, approximately 0.05 across the Little Cherry Creek area. Ground water in the tailings impoundment area discharges to Bear Creek and Libby Creek. Some of the water flowing beneath the tailings impoundment site discharges as springs in the proposed dam site area and downstream. Ground water in the Ramsey Creek LAD discharges either to Ramsey, Poorman, or Libby creeks. Ground water flow in the impoundment area is generally easterly following the surface topography; a map showing ground water elevations is presented in Noranda's supplemental petition information (Noranda Minerals Corp., 1992a). Of the six wells established in the Ramsey LAD area, one was artesian.

Aquifer tests were conducted in the glaciofluvial deposits and in the filled channel in the tailings impoundment area. The hydraulic conductivity of the glaciofluvial deposits range from 0.05 to 145 gpd/ft^2 (7 x 10^{-3} to 2 x 10^{-6} cm/sec.), with a mean of 51.5 gpd/ft^2. Estimates of transmissivity (a measure of the rate at which ground water is transmitted through a unit width of aquifer) range from 1.3 to 945 gpd/ft, with a mean of 455 gpd/ft. Estimates of the hydraulic conductivity and transmissivity of the filled channel ranged from 0.5 to 2.7 gpd/ft and 25 to 120 gpd/ft^2, respectively.

Hydraulic conductivities of the lacustrine deposits ranged from less than 0.2 to 0.85 gpd/ft^2 ($<10^{-6}$ to 4 x 10^{-5} cm/sec.). Although saturated, the fine-grained lake deposits did not yield measurable water in the boreholes. The lacustrine deposits act as confining layers where they overlie more permeable deposits. Where the lacustrine deposits underlie more permeable deposits, perched conditions exist.

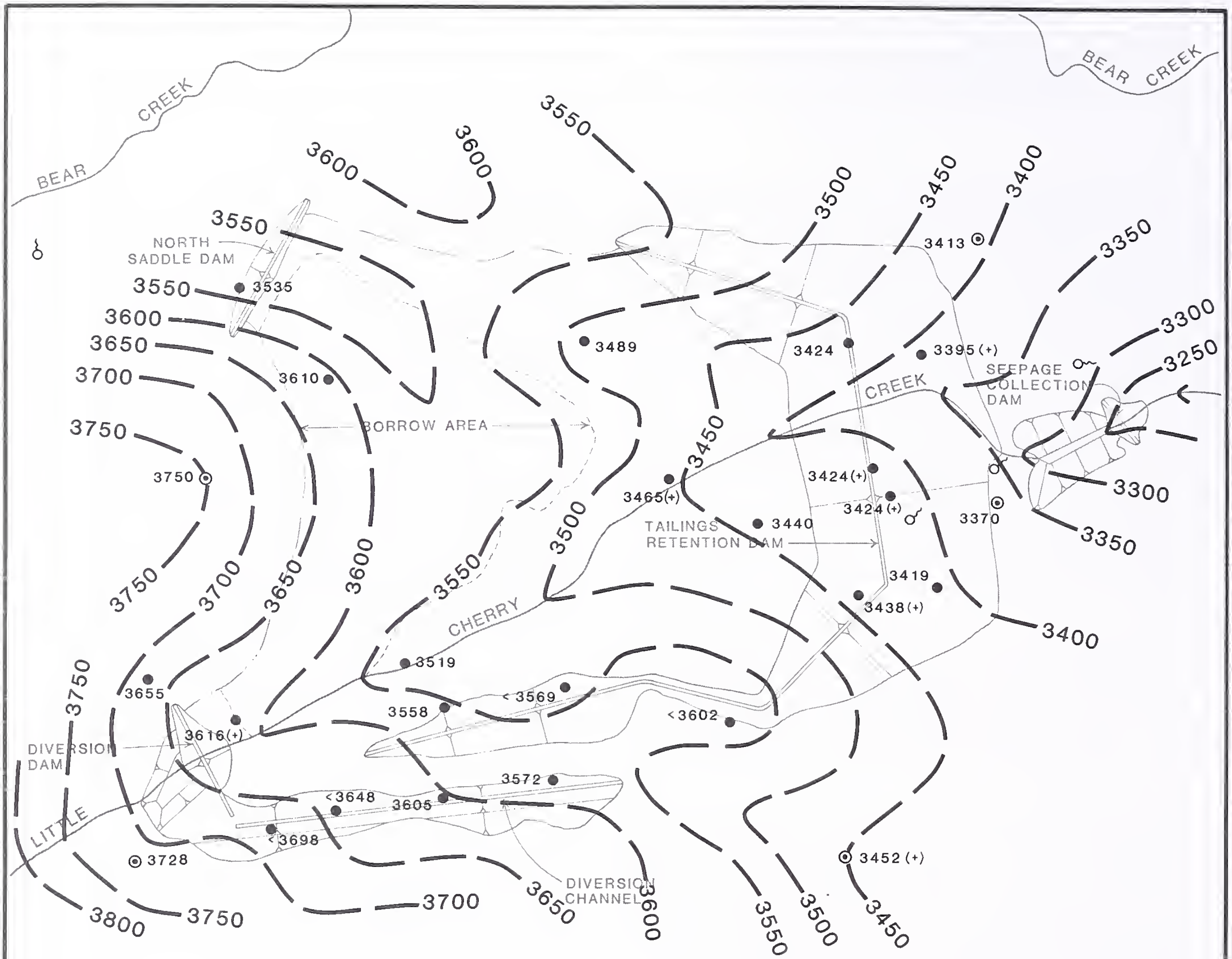
The glaciofluvial deposits are capped by the relatively impermeable lacustrine deposits. These deposits allow hydraulic pressures to build and create the confined (or artesian) flow conditions observed in the Poorman Creek and Little Cherry Creek areas. In the tailings impoundment area, the water levels observed in monitoring wells are quite variable, ranging from below the bedrock-soil contact to above the ground surface, indicating artesian conditions.

Well, spring, and adit inventory. No existing wells were identified in the mine area. The nearest well to the mine area is located at the Howard Lake Campground. Several springs (Table 3-17) and one discharging mine adit (the Heidelberg adit) were identified in the mine area. Most identified springs occur in the Little Cherry Creek and Bear Creek drainages (Figure 3-7). These springs are relatively small, discharging less than 4 gpm. Other springs in the project area (Table 3-17) originating from colluvium or bedrock discharge at higher rates (4-50 gpm). High mountain springs observed in the area (T. Webster, DSL Hydrologist, pers. comm. w/ J. Zimpfer, April 26, 1990) may be related to a ground water system along the Rock Creek Fault, and flows show large fluctuations from spring to summer.

During hydrologic baseline studies by Chen-Northern, Inc.(1989), the Heidelberg Mine adit, near the head of Rock Creek, was observed to flow in the spring; in the summer, only standing water was observed. During geotechnical evaluation of the Heidelberg Mine adit by Morrison-Knudsen in August, 1989, ground water flow in the adit was estimated to be 80 gpm.

Ground Water Quality

Baseline ground water quality monitoring was conducted primarily in the ground water system at the tailings impoundment site. Wells in the Ramsey Creek LAD area were established in late 1991. Ground water samples from monitoring wells in the tailings impoundment area show the existing water quality to be very good. Ground water is a calcium bicarbonate or calcium-magnesium bicarbonate type.



Source: Morrison-Knudsen Engineers, Inc. 1989c.

LEGEND

- Boring, With Piezometric Pressure Head. (+) Where Flow Is Artesian At Surface
- Monitor Well (By Chen-Northern)
- Spring
- Approximate Contour of Piezometric Head

NORTH
0 400 800
FEET

FIGURE 3-7.

GROUND WATER LEVELS IN THE PROPOSED TAILINGS IMPOUNDMENT AREA

Measured total dissolved solids were low (<120 mg/L), and pH values were near neutral (generally 7.4 to 7.6). Most metals concentrations were at or below analytical detection levels. Manganese and cadmium were the only trace metals consistently identified in ground water samples (Table 3-18).

Ground water quality in the Ramsey Creek LAD area also is very good (Table 3-18). Total dissolved solids are lower than in the tailings impoundment area, and pH is neutral to slightly acidic. Ground water is a calcium-bicarbonate type. Dissolved metal concentrations are very low. Except for cadmium and manganese, metal concentrations were below detection limits.

Limited information is available on bedrock ground water quality. Under the DSL permit to construct the Libby Creek adit, Noranda is collecting adit inflow water samples for analysis (Table 6-10 in Chapter 6). Except for manganese and zinc, all metal concentrations were below the detection limit. Chen-Northern, Inc. (1990) sampled a bedrock spring (SP-16) near the Heidelberg Mine during July, 1989. Concentrations of all analytical parameters were very low, with all metals except molybdenum below the detection limit (Table 3-18). Total dissolved solids and total hardness are also below detection limits, indicating the water contains few dissolved constituents.

Table 3-17. Springs occurring in the mine area.

Spring	Location	Elevation (feet)	Discharge (gpm)	Geologic source
Tailings impoundment area				
SP-01	Below saddle between Bear Creek and Big Cherry Creek	3,500	2-3	Lacustrine silts
SP-02	Little Cherry Creek	3,320	1-2	Lacustrine silts
SP-10	Little Cherry Creek	3,350	1	—
SP-11	West side of Libby Creek	3,370	0.5	—
SP-12	West side of Libby Creek	3,390	—	—
SP-13	South side of Bear Creek	3,410	—	—
SP-14	West side of Libby Creek	3,350	0.2	—
SP-15	Little Cherry Creek	3,420	1.5-2.0	—
SP-17	South side of Bear Creek	3,560	0.5	—
SP-18	South side of Bear Creek	3,550	2.0	—
Other springs in project area				
SP-03	Lower east slope of Cable Mountain	4,320	4-5	Colluvium
SP-04	Upper Libby Creek	4,200	8.9	Colluvium
SP-05	Rock Creek, NE of Heidelberg Mine	4,350	5-7	-
SP-16	Rock Creek, SE of Heidelberg Mine	4,450	40-50	Bedrock

Sources: Chen-Northern, Inc. 1989. p. 4-14.
Noranda Minerals Corp. 1989h. p. 24-26.
Chen-Northern, Inc. 1990. Appendix D.

Table 3-18. Ground water quality in the project area.

Parameter	Tailings impoundment area						
	DH-015	LCM-009	LCM-010	LCM-011	LCTM-008	PLCM-6DP	PLCM-6SH
Date sampled from	11/15/89	8/19/88	8/16/88	8/15/88	8/17/88	8/18/88	8/18/88
Date sampled to	8/22/91	8/24/91	8/22/91	8/22/91	8/24/91	8/24/91	8/24/91
Number of samples	3	7	7	7	6	6	7
Specific conductance (µmhos/cm)	174	168	150	159	174	163	145
pH (standard units)	7.5	7.0	7.3	8.1	7.1	7.4	7.6
Temperature (°C)	9.0	8.4	6.9	7.9	7.8	7.3	7.4
Nitrate/Nitrite Nitrogen (mg/L)	0.27	0.36	0.14	0.16	0.20	0.05	0.16
Total dissolved solids (mg/L)	108	97	101	99	100	98	101
Fluoride	0.09	0.13	0.15	<0.09	0.09	<0.07	<0.07
Total Hardness (as $CaCO_3$)	89	83	63	85	86	94	90
Total Alkalinity (as $CaCO_3$)	100	90	80	102	94	94	99
Major cations (mg/L)							
Calcium	25.5	19.4	16.3	21.6	19.8	24.9	20.7
Magnesium	6.1	8.3	5.4	7.3	8.8	7.8	9.2
Sodium	7.5	5.7	9.6	10.0	4.8	<2.6	<3.3
Potassium	<0.8	<1.3	9.6	<1.9	<1.2	<1.0	8.8
Major anions (mg/L)							
Bicarbonate (as HCO_3)	122	110	98	117	115	115	118
Carbonate (as CO_3)	N.D.	N.D.	N.D.	4	N.D.	N.D.	1
Chloride	<1	<1	<2	<2	<1	<1	<1
Sulfate	<2	<2	8	<5	<2	<2	<3
Dissolved metals (mg/L)							
Aluminum	<0.1 (3)	<0.2 (4)	<0.2 (3)	<0.3 (4)	<0.1 (6)	<0.1 (6)	<0.3 (3)
Arsenic	<0.005 (3)	<0.005 (7)	<0.005 (7)	<0.005 (7)	<0.005 (5)	<0.005 (6)	<0.005 (6)
Cadmium	<0.001 (3)	<0.001 (3)	<0.001 (3)	<0.001 (3)	<0.002 (3)	<0.001 (3)	<0.001 (3)
Chromium	<0.02 (2)	<0.02 (6)	<0.02 (7)	<0.02 (6)	<0.02 (5)	<0.02 (6)	<0.02 (7)
Copper	<0.013 (3)	<0.013 (7)	<0.013 (7)	<0.013 (7)	<0.012 (6)	<0.014 (6)	<0.013 (7)
Iron	<0.05 (3)	<0.12 (6)	<0.11 (4)	<0.17 (5)	<0.18 (3)	<0.05 (6)	<0.19 (4)
Lead	<0.007 (3)	<0.01 (6)	<0.01 (5)	<0.01 (6)	<0.01 (5)	<0.01 (6)	<0.01 (5)
Manganese	<0.02 (3)	<0.14 (3)	<0.45 (1)	<0.13 (3)	0.11 (0)	<0.02 (6)	<0.02 (5)
Mercury	<0.0002 (2)	<0.0002 (5)	<0.0002 (5)	<0.0002 (5)	<0.0005 (5)	<0.0002 (4)	<0.0002 (6)
Molybdenum	<0.05 (3)	<0.05 (7)	<0.05 (7)	<0.05 (7)	<0.05 (6)	<0.05 (6)	<0.05 (7)
Silver	<0.001 (2)	<0.001 (5)	<0.001 (6)	<0.001 (6)	<0.001 (5)	<0.001 (5)	<0.001 (7)
Zinc	<0.01 (3)	<0.05 (4)	<0.03 (5)	<0.02 (5)	<0.05 (5)	<0.02 (5)	<0.04 (5)

Source: Chen-Northern, Inc. 1989, 1990, 1991a, 1992a.
Values are averages and include some values below the analytical detection limit.
N.D. = not detected
For dissolved metals, number of samples below the detection shown in parentheses.
Some analytical results subject to quality assurance problems.

Table 3-18. Ground water quality in the project area (cont'd).

	—Adit area—		———Ramsey Creek land application disposal area———				
	(MW 2)		(MW 8)	(MW 5)	(MW 6)	(MW 7)	(MW 10)
Parameter	JPM-001†	SP-16	WDS-1 §	WDS-2	WDS-3	WDS-4	WDS-6
Date sampled from	9/20/89	7/21/89	2/27/92	2/27/92	2/27/92	2/27/92	2/27/92
Date sampled to	12/19/89	—	—	—	—	—	—
Number of samples	4	1	1	1	1	1	1
Specific conductance (μmhos/cm)	19	18	70	60	46	141	39
pH (standard units)	6.4	7.1	6.4	5.9	5.9	6.9	5.6
Temperature (°C)	5.0	4.5					
Nitrate/Nitrite Nitrogen (mg/L)	0.22	<0.07	0.32	0.34	0.30	0.30	0.34
Total dissolved solids (mg/L)	<25	<20	71	71	43	88	56
Fluoride	<0.05	<0.05	0.09	0.05	0.05	0.17	0.05
Total Hardness (as $CaCO_3$)	<12	<7	24	23	16	58	12
Total Alkalinity (as $CaCO_3$)	5	7	33	26	19	67	17
Major cations (mg/L)							
Calcium	<1	1	6.2	6.2	4.2	17.1	3.4
Magnesium	<2.3	<1	2.0	1.8	1.4	3.8	0.9
Sodium	<2.3	<1	3.1	5.6	1.5	6.2	2.4
Potassium	<4.3	<1	0.7	1.0	0.8	1.2	1.1
Major anions (mg/L)							
Bicarbonate (as HCO_3)	6	9	40	32	23	82	14
Chloride	<1	<1	<1	<1	<1	<1	<1
Sulfate	7	<1	7	8	5	5	5
Dissolved metals (mg/L)							
Aluminum	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.007	<0.0005	0.009	0.003	0.002	0.001	0.002
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	<0.015	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	<0.09	<0.02	<0.02	0.06	0.04	0.03	0.03
Mercury	<0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	<0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Sources: Chen-Northern, Inc. 1989, 1990, 1991a, 1992a.;
Noranda Minerals Corp., April 21, 1992—on file with the agencies.
Values for JMP-001 are averages and include some values below the analytical detection limit.
†Sampling period used to calculate averages for JPM-001 covers period prior to adit discharge.
§WDS-1 has been sampled twice yearly since 1989; other data is similar to that presented.
MW # refers to monitoring wells shown on Figure B-2; WDS-5 was dry at the time of sampling.

WETLANDS AND "WATERS OF THE UNITED STATES"

As discussed in Chapters 1 and 2, wetlands and "waters of the United States" are afforded certain regulatory protection under the Clean Water Act. Waters of the United States are defined in the regulations implementing the Clean Water Act as—

> "All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide, all interstate waters including interstate wetlands, all other waters, such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which would or could affect interstate or foreign commerce; all impoundments of waters otherwise defined as waters of the United States..., tributaries of waters [defined above]; the territorial sea; and wetlands adjacent to waters [defined above]...." (40 Code of Federal Regulations 230.3 and 33 Code of Federal Regulations 328.3)

Wetlands are a subset of waters of the U.S. and are defined as—

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (40 Code of Federal Regulations 230.3 and 33 Code of Federal Regulations 328.3)

All perennial streams and their tributaries in the project area are "waters of the United States" as defined in the federal Clean Water Act (Figure 3-5). The proposed Little Cherry Creek tailings impoundment and widening the Bear Creek access road would affect waters of the United States (see Chapter 4).

Identified Wetland Resources

Wetlands delineated using the 1987 delineation manual are shown in Figure 3-8. Four types of wetland settings are delineated—

- Distinct areas comprised entirely of wetlands (W);
- Complexes of wetland and non-wetland areas (WC);
- Seep areas with less than 5 to 10 percent wetlands (S); and
- Linear feature wetlands along streams.

Most wetlands occur within the proposed Little Cherry Creek impoundment area. Other wetlands along the proposed access road and transmission line alternatives are not shown on Figure 3-8 because of their small size (less than one acre). A total of 14.4 acres of wetlands and 5.9 acres of waters of the U.S. would be affected by the project. Characterized in terms of function and value, three broad types of wetlands occur in the project area—herbaceous wetlands, herbaceous/shrub wetlands, and forested wetlands.

Herbaceous wetlands. About 0.5 acre of herbaceous wetlands occurs within the proposed tailings impoundment disturbed area. Herbaceous wetlands also occur downstream of the impoundment area. This type of wetlands occupies poorly drained depressions where water collects during the early part of the growing season and soils remain saturated for all or most of the growing season. Dominant species are beaked sedge, water sedge, knot-sheath sedge, and inflated sedge.

The ephemeral water supply of herbaceous wetlands does not support fish, but the wetlands do provide habitat for amphibians and birds. Wildlife use these wetlands seasonally as water sources when water persists. A variety of terrestrial and avian wildlife, including garter snakes, mink and great blue heron, prey on the aquatic organisms supported by these wetlands. Small numbers of waterfowl nest in herbaceous wetlands and use open water during migration.

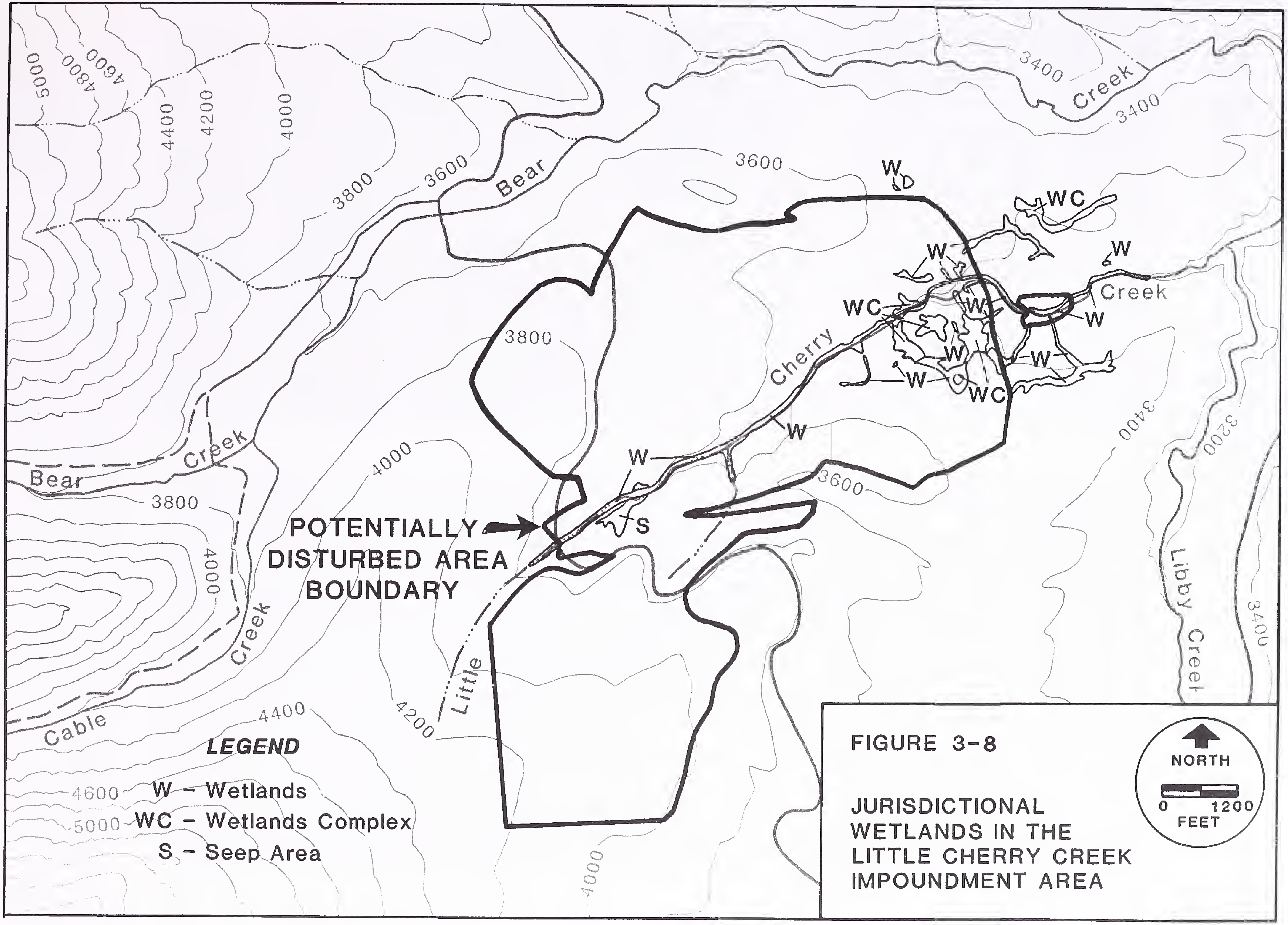


FIGURE 3-8

JURISDICTIONAL WETLANDS IN THE LITTLE CHERRY CREEK IMPOUNDMENT AREA

These wetlands also retain some sediment and nutrients. Most herbaceous wetlands, however, are very small and are not fed by significant drainage basins. Therefore, the value to the region of these wetlands to remove sediments and nutrients is limited.

Herbaceous/shrub wetlands. About 13.3 acres of herbaceous/shrub wetlands are in the proposed tailings impoundment disturbed area. Herbaceous/ shrub wetlands also occur downstream of the impoundment area. Widening the Bear Creek access road would disturb about 0.4 acre of this type. Herbaceous/ shrub wetlands typically occur at springs and seeps, and at the margins of poorly drained depressions where the forest overstory has been removed by logging. Dominant shrubs are Douglas spirea, alderleaf buckthorn, and Sitka alder. Common understory species are bluejoint reedgrass, beaked sedge, daggerleaf rush, water sedge, starry Solomon's seal, and stream violet. Herbaceous/ shrub wetlands provide forage and cover for wildlife. The rapid, prolific growth of the herbaceous/shrub wetlands type following logging helps to stabilize soil, reduce erosion, and prevent the spread of noxious weeds.

Forested wetlands. About 0.2 acre of forested wetlands occurs within the proposed Little Cherry Creek tailings impoundment area. A small area (about one acre) of forested wetlands along the Fisher River would be disturbed by the Swamp Creek alternative transmission line. Forested wetlands occur in unlogged riparian areas and at springs and seeps which have not had the overstory canopy removed. This wetlands type typically forms a narrow riparian zone along all perennial streams. Dominant overstory species include western red cedar, western hemlock, Engelmann spruce, and black cottonwood. Shrubs include Sitka alder, Rocky Mountain maple, devil's club, Pacific yew, and red-osier dogwood. Dominant herbaceous plants include lady fern, oak fern, Columbian monkshood, reed mannagrass, bluejoint reedgrass, arrowleaf groundsel, and common horsetail.

Forested wetlands provide habitat for wildlife that utilize both wetlands and upland habitats for food and cover, including big game mammals, reptiles, amphibians, and a diversity of birds. Wetlands in riparian areas are recharge and/or discharge areas where surface water and ground water are connected. Riparian vegetation helps stabilize stream channels and trap sediment during floods while reducing sediment contributions from adjoining uplands. Trees and shrubs also help slow the velocity of flood waters. Forested wetlands in the project area, however, have a relatively low value for alleviating flooding because of their small area and relatively insignificant floodwater storage potential.

AQUATICS

Noranda's aquatic biology baseline studies encompassed reaches in five study area streams. Physical habitats were evaluated using the General Aquatic Wildlife System (GAWS) of the U.S. Forest Service (1985 and 1988). This system calculates indices for riparian habitat condition, fishery habitat condition, and habitat vulnerability.

Physical Characteristics

Riparian habitat condition was found to be good or excellent throughout the study reaches, with the exception of the braided reach of Libby Creek, below its confluence with Poorman Creek, which was fair. The physical effects of abandoned placer mining operations are evident throughout this reach.

The habitat vulnerability index rates sites for their potential susceptibility to aquatic habitat degradation. Portions of the lower two sampling reaches in Libby Creek, all reaches of Ramsey Creek, and the upper reaches of Bear Creek were rated as potentially vulnerable to degradation. Other reaches of the study area rated moderate to low in vulnerability potential.

The habitat condition index is a general measure of potential fishery habitat. For streams in the project area, index components measuring bank cover and stability were high, while measures of pool quality

and quantity were typically lower, resulting in an overall reduction in area stream scores. Habitat condition values for project area streams are shown in Table 3-19.

Table 3-19. Habitat condition values for project area streams.

Creek	Range Min.	Range Max.	Average
Bear	59	87	76
Little Cherry	55	82	66
Libby	50	83	70
Poorman	59	62	60
Ramsey	48	82	63

Source: Western Resource Development Corp. 1989a., p. 22.

Average potential spawning areas for the surveyed stream reaches range from four percent for the Ramsey Creek upper reach to 45 percent for the downstream reach of Libby Creek. Gravel substrates generally account for 20 to 40 percent of the streambed at the Libby Creek sampling stations. Average potential rearing area ranges from eight percent in Poorman Creek and the upper reach of Libby Creek, to 99 percent for the upstream reach of Ramsey Creek. The most likely locations for spawning in Libby Creek include reaches downstream from its confluence with Bear Creek, near its confluence with Poorman Creek, downstream from Ramsey Creek, and downstream from Howard Creek.

Other probable spawning areas for streams draining the project area include reaches in Bear Creek downstream from the Bear Creek Road, and the reach of Poorman Creek above its confluence with Libby Creek.

Chemical Characteristics

Dissolved mineral and nutrient concentrations in the streams are generally near or below their respective analytical detection limits. These extremely low concentrations severely limit the productivity potential for aquatic life.

Because of very low alkalinities, the streams in the project area are very poorly buffered. Consequently, surface waters tend to be slightly acid (pH 6 to 7). This acidity has two likely natural sources—organic acids originating from surrounding coniferous forests, and dissolved carbon dioxide (CO_2) both in surface waters and soil waters draining into the area streams. Water hardness in the Libby Creek drainage is below 20 mg/L as calcium carbonate ($CaCO_3$) for most samples analyzed. In some locations, maximum hardness is 5 mg/L as calcium carbonate ($CaCO_3$).

Aquatic Insects

Macroinvertebrate (aquatic insect) densities averaged 1,800 organisms per square meter to 2,500 organisms per square meter during baseline monitoring. (The lower density is attributable to the occurrence of a heavy rainstorm immediately prior to sample collection.) Both higher and lower densities have been observed since 1989 in the interim monitoring program. In total, 144 different types of macroinvertebrates were identified. Midges, mosquitos and flies are the most diverse group, and caddisflies, stoneflies, and mayflies are very common. Most macroinvertebrates are considered intolerant of fine sediments, heavy metals, and organic pollution.

Calculated indices characterizing macroinvertebrate communities indicate excellent water quality in the project area streams. Differences in community characteristics among the stations are generally slight. These differences are probably due to differences in stream order, microhabitat conditions, and variable sampling efficiencies.

For all sampling stations in the Libby Creek drainage system, average dry weight biomass for benthic macroinvertebrates ranged from a minimum of 0.03 g/m^2 at the most upstream station to 0.42 g/m^2 at the

most downstream station of Bear Creek. Using U.S. Forest Service (1985) criteria based on macroinvertebrate biomass, the potential to support fisheries in all project area stream reaches is rated as poor. The low benthic macroinvertebrate populations directly reflect the low nutrient concentrations in the mine area streams.

Aquatic Plants

Larger aquatic plants occur only incidentally. A few sprigs of water buttercup are found in spring seeps in the Libby Creek floodplain. Mosses are the predominant vegetation found along many stream reaches. They are particularly abundant in upstream portions of each stream, and are present wherever stable substrates and dense forest canopies occur. Mosses are essentially absent from Libby Creek's middle reaches.

Sparse growth of green algae, blue-green algae, and diatoms occur throughout the study area. In general, the algal taxa found were typical of unpolluted, softwater streams in Montana. The low population densities, common of high-elevation streams, reflect the low productivities and low nutrient contents in the Libby Creek drainage waters.

FISHERIES

Redband trout (hybrid of redband and cutthroat) is the dominant trout species in all study area streams, ranging from 63 percent of the sampled population in Ramsey Creek, to 100 percent of the sampled population in Little Cherry Creek. Trout densities are low, exceeding one trout per 100 linear feet only in Little Cherry Creek. Trout populations are further characterized in Table 3-20.

Most fish at the downstream Poorman Creek site were slimy sculpins. Following completion of baseline studies, KNF personnel completed genetics and fish sampling in project area streams. These studies indicated that a population of torrent sculpins inhabited Libby Creek downstream of the U.S. 2 bridge crossing.

Most trout were young (age I, II, and III). This is typical for low productivity mountain streams. Older (age IV) redband trout were found only in Ramsey Creek, while age IV bull trout were found in upstream reaches of both Ramsey Creek and Libby Creek. Age V bull trout were found only in the upstream reach of Ramsey Creek. Growth rates for all age classes are low, primarily due to limitations caused by extremely low nutrient concentrations.

Table 3-20. Redband and bull trout population characteristics in project area streams.

Stream	Densities (fish/100 ft^2)	redband trout average length (in.)	redband trout average weight (oz.)	bull trout average length (in.)	bull trout average weight (oz.)
Libby Creek (between Little Cherry and Bear creeks)	0.4	4.9	0.8	4.8	0.5
Libby Creek (upstream of Ramsey Creek)	0.2	not found		7.5	4.0
Ramsey Creek (upstream of Libby Creek confluence)	0.5	4.9	1.0	5.4	1.4
Poorman Creek (upstream of Libby Creek confluence)	0.8	4.7	0.8	6.6	1.8
Little Cherry Creek (upstream of Libby Creek confluence)	1.7	3.7	0.4	not found	

Source: Western Resource Development Corp. 1989a. pp. 53, 56, and 58.

During the baseline study, two spawning areas made by large, apparently migratory bull trout were found below the falls on Libby Creek (downstream of the project area). Above the falls, ten small bull trout redds were also found, which were obviously the product of resident fish. No spawning was observed in Ramsey Creek or Poorman Creek. Also, no spawning by mountain whitefish was observed.

Portions of all three transmission line routes follow and cross the Fisher River. This section of the river holds resident rainbow trout and mountain whitefish and migratory rainbow, whitefish, and bull trout. The Miller Creek and North Miller Creek routes run along the north side of Miller Creek. Rainbow trout are the predominant species in the creek, comprising 73 percent of the fish population. Other fishes include cutthroat trout (16 percent); brook trout (9 percent); and sculpin (2 percent). Only 20 fish of the 290 fish sampled (7 percent) were over 7 inches long—the longest being a 9-inch brook trout (D. Perkinson, KNF Fisheries Biologist, pers. comm., w/ Scott McCollough, DNRC). The Swamp Creek alternative transmission line route crosses Schrieber Creek; it is expected to have fish populations similar to Miller Creek.

Heavy Metals

Concentrations of five metals in redband trout muscle are shown in Table 3-21. Except for mercury, regulatory criteria for metals concentrations in fish have not been established. The U.S. Food and Drug Administration has established a mercury standard of one µg/g. Concentrations of mercury in the sampled fish are below this standard.

Threatened, Endangered, or Sensitive Fish Species

No fish species listed as threatened or endangered by the U.S. Fish and Wildlife Service (50 CFR 17) were found in the project area. The white sturgeon is a Category 1 species whose situation warrants listing. Bull trout and Interior redband, however, are currently under a Notice of Review, Category 2 status (which is applied to a species that may be threatened or endangered but for which there is not substantial biological information). Bull trout and redbands are present in the project area (Table 3-20), but white sturgeon are not.

Table 3-21. Metals concentrations in redband trout—Libby Creek (in µg/g).

Metal	Range Min.	Range Max.	Average
Cobalt	0.1	12.4	1.9
Copper	2.4	29.4	6.5
Lead	<0.1	<1.4	<0.5
Mercury	0.1	0.4	0.19
Zinc	22.3	62.8	30.1

Source: Western Resource Development Corp. 1989a. pp. 69-70.

The KNF classifies white sturgeon, interior redband trout, westslope cutthroat trout and torrent sculpin as sensitive. The Montana Natural Heritage Program classifies the white sturgeon as historically known, the Interior redband trout as critically imperiled, the westslope cutthroat trout as rare, and torrent sculpin as imperiled. Neither white sturgeon nor westslope cutthroat trout are known to inhabit project area streams. White sturgeon inhabit the Kootenai River downstream of the Kootenai Falls, more than 30 river miles downstream of the project area. Fish populations including genetically pure and hybrid Interior redband trout were found during KNF sampling surveys in tributary streams within the project area. Although these samples were not adequate to define the degree of hybridization for each Libby Creek tributary, this metapopulation of hybrid cuttbows is a combination of redband, coastal rainbows and westslope cutthroat trout. This condition qualifies as an Experimental Redband Population that is in need of genetic restoration work. Torrent sculpin are found in Libby Creek downstream of the project area near the U.S. 2

crossing, where they are relatively abundant (D. Perkinson, personal communication, KNF). Additional information on USFS sensitive fish species is presented in the *Biological Evaluation for Fish Species* on file with the KNF.

Historic Impacts on Fisheries

Baseline aquatic data reflect the major influences that historic mining activities have had on fishery and habitat conditions in Libby Creek. Prior to the 1860s, the upper valley was essentially intact, influenced primarily by wildfires and floods. While Indians used the upper valley for subsistence purposes (harvesting berries and wildlife), upper Libby Creek was not among those streams routinely used for fishing.

In 1867, placer mining began in Libby Creek and all of the tributaries within the project area. By 1868, about 800 miners were working the bed of Libby Creek and its tributaries, diverting streams, and cutting timber for housing and placer works. Left behind were scattered patches of disturbed streambed, floodplains devoid of timber, and degraded trout habitat. Miners subsisted in part on the fish that remained.

In 1887, the mining community of Old Libby was established in the area. From 1890 to 1937, hydraulic mining extended a second wave of mining impacts on fisheries in the upper valley of Libby Creek. After excavating and washing old stream channels, floodplains, and streambanks for gold and silver, the "waste" was left in place or allowed to wash down river. This period also saw underground mining begin, which increased the leaching of other metals, including copper and lead, into these streams. Use of mercury in the processing of ore increased, and samples today reveal residual mercury concentrations in and around stream channels. In 1893, a federal surveyor noted that the waters of upper Libby Creek were "tainted" by human occupation and mining works (Mumbrue, 1893).

In 1915 steam-operated mining equipment was used in Libby Creek. Large draglines and steam shovels dug into the bed and floodplain. Because a severe wildfire virtually stripped the valley of all standing timber in 1910, little habitat or fish resource was left to be affected by "steam mining." Photos from the period indicate that Libby Creek was a wide, shallow stream with a cobble/gravel substrate. The few fish that remained probably were restricted to the headwaters, where only placer miners had been. Heavy equipment and hydraulic mining continued into the 1940s, after which time only a few placer miners remained. The first non-native fish (rainbow trout from California and brook trout from the East) were imported by rail in 1914 and released in local streams (*The Western News*, May 28, 1914).

Eighty years of mining and periodic wildfire in upper Libby Creek and the lower end of its tributaries destroyed most of the fish habitat in the Libby Creek drainage. The fish habitat that remained was concentrated in the upper headwaters of tributaries, including Bear, Ramsey, and Poorman creeks. Floods and regrowth of conifers have begun to stabilize the stream system in the upper valley. Many decades will pass, however, before natural processes will restore the fish habitat to pre-1860 conditions.

WILDLIFE

The project area supports abundant and diverse wildlife populations. During the baseline surveys, 35 mammal species, 10 raptor species, 94 other breeding bird species, three reptile, and five amphibian species were recorded in the study area. (The study area encompassed an area larger than the project area. See Chapter 6 for more discussion of collection of wildlife baseline data.) Common and scientific names for species recorded in the wildlife study area are available in the KNF project file and in the baseline report (Western Resource Development Corp., 1989d).

Forty-three species of special concern potentially inhabit the project area. Three of these species

(northern Rocky Mountain wolf, bald eagle and peregrine falcon), are listed as endangered; the grizzly bear is listed as threatened by the U.S. Department of Interior. Two others, wolverine and lynx, are considered candidate species which may be suitable for listing, but sufficient data are lacking to do so at the present time. Species of special concern are discussed in greater detail in a subsequent section.

Habitat Types

The habitat types found in the project area are typical for the Northern Rocky Mountains. Eleven wildlife habitat types are present in the mine area (Table 3-22). Four of these types account for almost 85 percent of the mine area. Each habitat type is briefly described in the following sections. Information on wildlife habitats in the transmission line corridor area is presented following the habitat type descriptions.

Mixed conifer. Mixed conifer habitat encompasses about 34 percent of the mine area. It is characterized by a visually dominant tree canopy comprising a variety of tree species. It provides hiding and thermal cover for moose, white-tailed deer, mule deer, elk, and black bear. Some portions of the habitat have an ample understory which also provides forage for big game. Fifty species of breeding birds and eight species of small mammals were identified in this habitat. Common species are Townsend's warbler, golden crowned kinglet, pine siskin, red-tailed chipmunk, and bushy-tailed woodrat. Black swift, downy woodpecker and mountain bluebird occurred only in mixed conifer habitat.

Table 3-22. Wildlife habitat types in mine area (in acres).

Habitat type	Mine area	Study area†
Riparian	589	711
Western hemlock	358	725
Mixed conifer	2,654	9,819
Clearcut	1,755	3,256
Shrub field	904	4,285
Spruce-fir	1,195	6,469
Rock	124	4,362
Grassland	58	1,365
Lodgepole pine	59	232
Forb field	15	152
Aquatic	15	105
Total	7,727	31,481

Source: Western Resource Development Corp. 1989d. p. 41.
†See Chapter 6 for delineation of wildlife study area

Clearcut. Clearcut habitat comprises 23 percent of the mine area. Vegetation in clearcut habitat varies with the age of the clearcut. Young habitat is dominated by shrubs and forbs. As they age, clearcut habitats mostly comprise coniferous trees. During the baseline surveys, 48 species of breeding birds and five species of small mammals were found in clearcut habitats. Common species include dark-eyed junco, pine siskin, chipping sparrow and deer mouse. American kestrel, northern pygmy owl, common nighthawk, black-billed magpie, house wren and cedar waxwing occurred only in clearcut habitat.

Spruce-fir. Spruce-fir habitat occupies 15 percent of the proposed project area. It is dominated by Engelmann spruce and subalpine fir. It provides cover for most of the big game species in the area. It is particularly important to mountain goats during the winter, when it provides both food and cover. Spruce-fir is used by 58 species of breeding birds, such as Swainson's thrush, winter wren and least flycatcher, and seven species of small mammals. Sighting of great horned owl, Clark nutcracker and red squirrel occurred only in spruce-fir habitat of the mine area.

Rock. Rock habitat comprises 1.6 percent of the mine area. It is found primarily in alpine areas. Steep rock faces, which comprise a portion of the

habitat, provide escape terrain and foraging for mountain goats. Rock habitat also provides potential nesting areas for raptors, such as golden eagle and prairie falcon, although no raptors were found during surveys of the mine area.

Shrubfield. Shrubfield habitat constitutes 12 percent of the mine area. It contains a wide variety of shrubs, which provide food and cover for black bear, mule deer, white-tailed deer, moose and elk. Fifty-seven species of breeding birds and six species of small mammals were found in shrubfields during the baseline surveys. Common species include Rufous hummingbird, MacGillivray's warbler, chipping sparrow, and deer mouse. Lincoln's sparrow, white-crowned sparrow and American goldfinch occurred only in shrubfield habitat.

Riparian. Riparian habitat is found along stream courses and around lake shores. It is limited in extent and covers 7.6 percent of the mine area. Even though its extent is limited, riparian areas are an important habitat type, having the highest density, most individuals, and most species of breeding birds, indicating that it is the most diverse and productive habitat in the mine area. It is the main habitat type used by moose and white-tailed deer. It also provides forage for black bear, mule deer and elk. During the baseline surveys, 63 species of breeding birds and six species of small mammals were observed in riparian habitat. Common species include American robin, black-capped chickadee, song sparrow, red-tailed chipmunk and deer mouse. Nine avian species, mallard, common snipe, belted kingfisher, tree swallow, violet-green swallow, veery, vesper sparrow, western meadowlark, and Brewer's blackbird occurred only in riparian habitat.

Western hemlock. Western hemlock habitat comprises 5 percent of the proposed project area. It provides hiding cover for most big game species and is the least diverse habitat type, supporting only 37 species of breeding birds and five species of small mammals. Common species include golden-crowned kinglet, chestnut-backed chickadee, red-breasted nuthatch and deer mouse. Only one species, barred owl, was found exclusively in western hemlock habitat.

Other wildlife habitat types. Four other wildlife habitat types—grassland, lodgepole pine, forbfield and aquatic—each occupy less than one percent of the mine area. Although they are important to some wildlife species, they are very minor components of the study area and were not sampled for breeding birds and small mammals during the baseline surveys.

Lodgepole pine may be expected to provide cover for big game; grassland provides forage for most big game species; and aquatic habitat provides water for a variety of wildlife species, including waterfowl and shorebirds. Grassland occurs along valley bottoms and lower mountain sideslopes. It provides forage for a number of big game species and forage and cover for small mammals.

Habitat types of the transmission line corridor. Most descriptions of wildlife habitat types of the mine area also apply to wildlife habitat types in the transmission line corridor. The mine area types are more finely divided (Table 3-23). All routes for the transmission lines cross similar mileages of wildlife habitat types and may affect stands of old growth timber. These stands, supplying important habitat for some species of special concern, are managed for wildlife by the KNF.

Important Wildlife Species

Nine big game species, several species of waterfowl, three upland game bird species and assorted predators, small mammals and song birds occur in the project area. Included in these are eight KNF Management Indicator Species.

Black bear. The Cabinet Mountains support some of the highest black bear densities in Montana, with 47 black bears observed during the baseline surveys. Black bears range throughout the project area. During spring, they mostly are found below

snowline throughout the mine area including the Libby, Poorman, and Ramsey drainages; in summer, they concentrate on Great Northern Mountain and in the upper reaches of Rock Creek. Peak black bear numbers during 1988 in the project area were estimated to be between 108 and 146 bears.

Black bears, as opportunistic feeders, feed on both plant and animal materials. They will eat grasses, forbs, berries, insects, carrion, fish and other animals they have caught. Analysis of 17 spring bear scats in the project area indicates that grasses and forbs, growing primarily on open slopes and meadows, are the bears' primary foods during the spring period. Berries, such as those found in shrubfields, are important food in summer and early fall.

Mountain goat. Mountain goats are a Management Indicator Species. They are found primarily in alpine habitat and high elevation coniferous forest stands throughout the year (Figure 3-9). They use steep rock outcrops and escarpments for escape from predators, and feed on vegetation found in the rock crevices. They use coniferous timber to escape from severe weather, particularly during winter. Mountain goats eat a wide variety of foods, but in the Cabinet Mountains, shrubs are the major component of their diet year-round. Grasses are also consumed when available. In winter, they browse on trees (Joslin, 1980).

In the project area, 40 to 55 mountain goats were estimated to occupy rocky ridges during 1988/89. Most of the activity is in the Rock Creek, Libby Creek and Fisher Creek drainages, but some solitary males can be found in Ramsey Creek and Poorman Creek areas. During baseline studies, most goats in the area wintered in Rock Creek, but two were observed above Libby Creek and one above Ramsey Creek. The Montana Department of Fish, Wildlife, and Parks has identified the area above Rock Creek as confirmed winter range; the south-facing slopes above Fisher Creek as probable winter range; and south-facing slopes above Libby, Ramsey and Poorman creeks as possible winter range (Joslin, 1980).

Moose. Moose use riparian habitat throughout the year along the various creeks in the project area. They also use drier mid-elevation areas during summer. Their food consists primarily of shrubs, with some forbs during summer. In the project area, moose concentrate along riparian areas, in 15- to 20-year-old clearcuts with shrubby understories, in

Table 3-23. Miles of wildlife habitat types crossed by transmission line route alternatives and corresponding mine area habitat types.

Corridor wildlife habitat type	—Miles crossed by transmission line alternative— 1	4	5	6	Corresponding mine area wildlife habitat type
Coniferous forest	13.1	13.3	12.0	11.4	Western hemlock Mixed conifer Spruce-fir Lodgepole pine Rock
Clearcut	2.9	2.8	3.7	5.1	Clearcut
Riparian	0.6	0.6	0.6	0.6	Riparian

Source: Noranda Minerals Corp. 1989c. and DNRC, 1992.

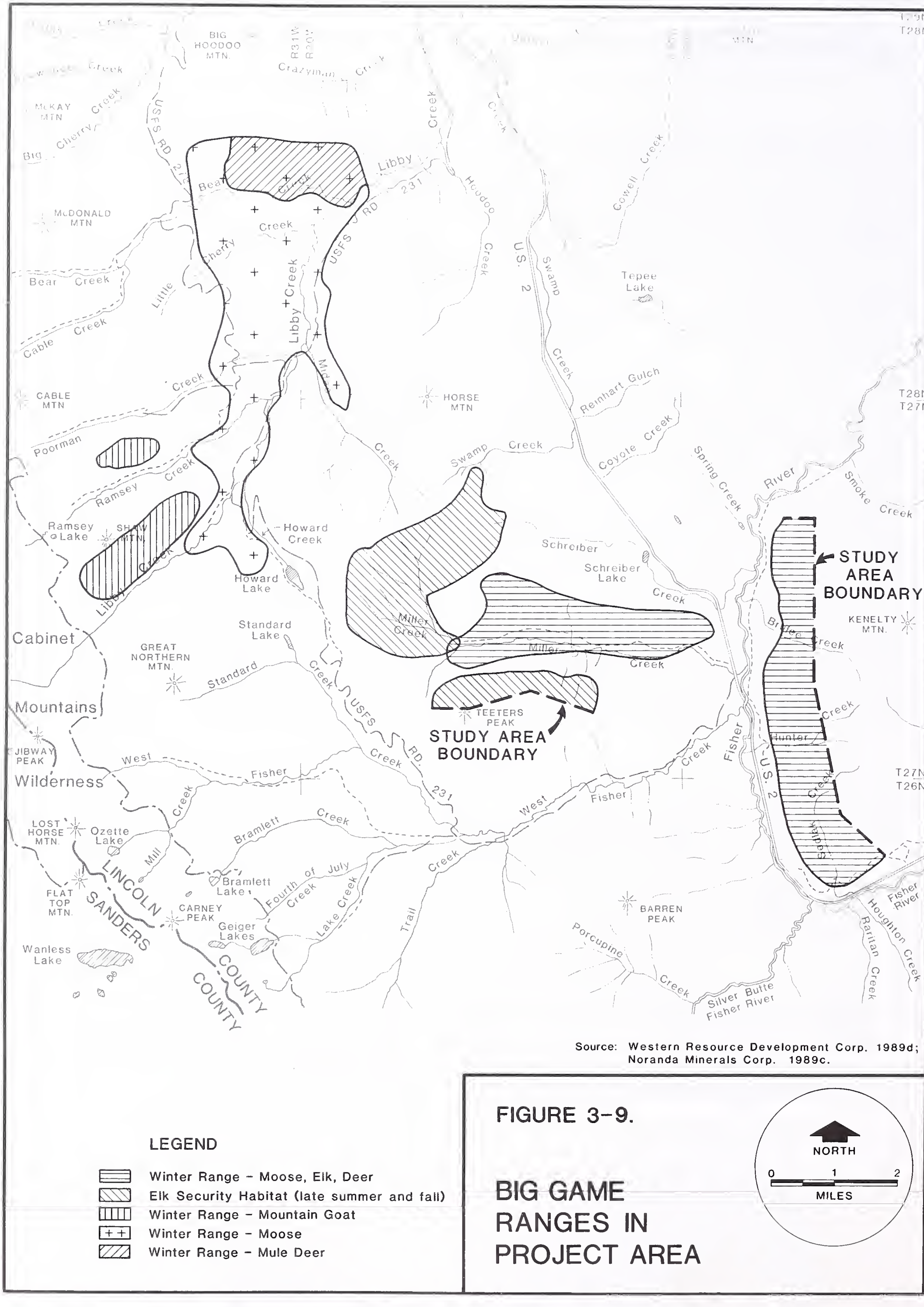


FIGURE 3-9.

BIG GAME RANGES IN PROJECT AREA

shrubfields, and in forested areas with shrubby understories.

During late fall and winter, they concentrate along Little Cherry Creek, Miller Creek, on Big Hoodoo Mountain and west-facing slopes above the Fisher River (Figure 3-9). They also use areas west of Libby Creek between Bear Creek and Howard Creek; there is some winter use along Ramsey Creek and upper portions of Libby Creek. It was estimated that between 60 and 170 moose were in or near the tailings impoundment area in December of 1988. Research studies conducted by the Montana Department of Fish, Wildlife and Parks during the winter of 1991-92 indicated that about 6 to 12 moose per square mile occupy the tailings impoundment area (J. Brown, MDFWP Biologist, memo to J. Cross, 12/27/91).

White-tailed deer. White-tailed deer are probably the most abundant ungulate in the project area and are a Management Indicator Species. Their activity focuses on areas within one mile of riparian habitat along all drainages in the project area. White-tailed deer will browse both deciduous and coniferous trees in winter. In spring, they switch to green grasses and forbs, while the summer diet is high in forbs with some deciduous browse. In fall, they gradually switch back to browse (Peek, 1984).

A few white-tailed deer winter along the lower elevations of Libby Creek, but the vast majority leave the mine area to winter along Miller Creek and east of U.S. 2 (Figure 3-9).

Mule deer. Mule deer are abundant throughout the project area where they can be found in all habitat types. Although their range greatly overlaps white-tailed deer, they tend to be found at higher elevations and in more open habitat. Mule deer diets are dominated by forbs and browse throughout the year, with forbs preferred when available. Forbs dominate the diet in spring and summer, with use of browse increasing during the fall and winter (Wallmo and Regelin, 1981).

Mule deer use the project area primarily in summer, spring and fall. They winter on Big Hoodoo Mountain, along Miller Creek, and to the east of U.S. 2 (Figure 3-9). There is also some seasonal transitional range along Little Cherry Creek and Bear Creek.

Elk. Elk are a Management Indicator Species. They are perhaps the least abundant ungulate in the project area, where they use all the drainages. Generally, elk use timbered areas for cover and open areas for feeding. Forested areas also present opportunities for elk foraging in the understory. Elk are adaptable and eat a wide variety of plant materials, but prefer to eat grasses when available. During summer months, forbs are also an important component of elk diet. During the winter, browse can be a main dietary component, especially if grasses are unavailable (Nelson and Leege, 1982).

Elk distribution in the project area appears to be spotty, but during spring, summer and fall, most of the project area may be used at some time. More activity is found at higher elevations. There is probably a traditional calving area on Big Hoodoo Mountain; other suitable calving habitat occurs in the upper drainages of West Fisher, Libby, Ramsey and Poorman creeks. During mild winters, elk winter on Big Hoodoo Mountain, while they move to Miller Creek and east of U.S. 2 during more severe winters (Figure 3-9). No elk were observed on Big Hoodoo Mountain during the "normal" winter of 1988/1989. Elk avoid hunters by seeking out areas of rough terrain, dense forests, and low road densities. KNF and MDFWP have identified these "security areas" in the Miller Creek headwaters and around Teeters Peak (Figure 3-9).

Mountain lion. Mountain lions are probably common in the mine area, although little is known about their distribution. The mine area is within an area with some of the highest lion densities in Montana (Western Resource Development Corp., 1989d). Signs of mountain lions were observed along Poorman Creek and Bear Creek. One lion

moved from the Poorman Creek drainage into Libby Creek, and another from Bear Creek to Big Hoodoo Mountain. Their seasonal movement patterns probably follow those of deer, which are their main food source.

Upland game birds. Two upland game bird species, ruffed grouse and blue grouse, were observed during the baseline surveys. A third species, spruce grouse, is also reported to be present (A. Bratkovich, District Biologist, KNF, pers. comm., July 24, 1989). Ruffed grouse concentrate in riparian habitat and are found in all habitat types except clearcuts. Blue grouse are observed in fir-pine forests mainly along ridgelines. Spruce grouse occupy mid-elevation spruce-fir forests.

Waterfowl and shorebirds. Suitable habitat for waterfowl and shorebirds occurs on Howard Lake, Libby, Ramsey, and Little Cherry creeks. Howard Lake is the most heavily used, providing a resting area for migrating waterfowl. Up to 300 geese and 300 ducks have been counted on Howard Lake during late fall; however, specific flight paths are not evident. Mallard nesting exists on Howard Lake, Libby Creek and at a pond just west of the Little Cherry Creek loop road. Spotted sandpipers are known to breed in habitat found along Libby Creek. Evidence of the presence of harlequin duck, a sensitive species, was observed along Ramsey Creek during baseline study. Common sandpiper, killdeer, great blue heron, common goldeye, common merganser, and blue-winged teal are other species reported in the project area.

Raptors. Ten species of raptors were observed during the baseline surveys. American kestrels are confirmed nesters in the mine area. Observations indicate red-tailed hawk, northern goshawk and great horned owl probably nest there too. Sharp-shinned hawk, Cooper's hawk, northern pygmy owl, and barred owl may nest in the area. Osprey, golden eagle and great gray owl occur in the project area, but there is no indication these species nest in areas affected by mine facilities.

Other wildlife. Ninety-four breeding bird species other than raptors were identified in the mine study area during the 1988 breeding bird surveys. Ten other bird species were observed during the breeding season, but not during breeding bird plot counts. Bird densities are greatest in riparian habitat followed by spruce-fir, shrubfield, mixed conifer, western hemlock, and clearcut habitats.

Pileated woodpeckers are a Management Indicator Species. They were the second most common woodpecker observed during the baseline studies using all timbered habitat types except riparian. Although breeding was not confirmed, there were strong suggestions it occurred in the project area during 1988. Breeding has been confirmed elsewhere on the KNF (Western Resource Development Corp., 1989d).

Eleven species of small mammals were trapped on small mammal plots during 1988. Total small mammal abundance, as indicated by trapping, is greatest in the shrubfield habitat followed by spruce-fir, mixed conifer, clearcut, western hemlock, and riparian habitats.

A number of other mammal species not sampled quantitatively are also present in the project area. These include snowshoe hare, beaver, porcupine, weasels, coyote, pine marten, mink, and bobcat.

Threatened, Endangered, or Sensitive Species

Forty-three species of special concern potentially occur in the project area (Table 3-24). Four of these species (gray wolf, woodland caribou, bald eagle and peregrine falcon), are listed as endangered; the grizzly bear is listed as threatened by the FWS. The woodland caribou is not listed as endangered in Montana. Three others, Townsend's big-eared bat, wolverine and lynx, are considered candidate species which may be suitable for listing, but sufficient data are lacking to do so at the present time. The gray wolf, bald eagle, peregrine falcon and grizzly bear also are Management Indicator Species.

Table 3-24. Wildlife species of special concern in the project area.

Class Species	Status USFWS[a]	State[b]	KNF[c]	MNHP[d]	Presence[e]
Birds					
Common loon			S	S3	
Harlequin duck	C2	S	S	S2	
Osprey		S			P
Bald eagle	LE	S	E	S3	
Cooper's hawk		S			
Northern goshawk	C2	S			P
Golden eagle		S			P
Merlin		S			
Peregrine falcon	LE	S	E	S1	
Prairie falcon		S			
Upland sandpiper		S			
Long-billed curlew		S		S4	
Northern pygmy owl		S			P
Burrowing owl		S		S3	
Barred owl		S			P
Great gray owl		S		S3	P
Long-eared owl		S			
Flammulated owl		S	S	SU	
Boreal owl			S	S3	
Northern saw-whet owl		S			
Pileated woodpecker		S			P
Black backed woodpecker		S			
Olive-sided flycatcher		S			P
Western bluebird		S			P
Bobolink		S			
Brewer's sparrow		S			
Reptiles					
Northern alligator lizard				S3	
Amphibians					
Pacific giant salamander		S		S1	
Rough-skinned newt		S		S1	
Coeur d'Alene salamander		S	S	S2	P
Spotted frog	C2				
Tailed frog		S		S3	P
Wood frog		S		SU	

Source: Western Resource Development Corp. 1989d.
Footnotes on following page

Table 3-24. Wildlife species of special concern in the project area (cont'd).

Class Species	Status USFWS[a]	State[b]	KNF[c]	MNHP[d]	Presence[e]
Mammals					
Pygmy shrew		S			
Long-legged myotis		S			
California myotis		S		S2	
Townsend's big-eared bat		S	S	S2	
Hoary marmot		S			P
Northern bog lemming		S	S	S1	
Gray wolf	LE	S	E	S1	
Grizzly bear	LT	S	T	S3	P
Fisher	C2		S	S2	A
Wolverine	C2	S		S4	P
Canada lynx	C2	S	S	S3	H
Woodland caribou	C2	S	S	SH	

Source: Western Resource Development Corp. 1989d.

[a]Federal status of species as defined by the U.S. Fish and Wildlife Service:

LE—Listed Endangered

LT—Listed Threatened

C1—Notice of review, Category 1 (substantial biological information on file to support the appropriateness of proposing to list as endangered or threatened).

C2—Notice of review, Category 2 (current information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial biological information is not on file to support an immediate ruling).

3C—Taxa that have proven to be more abundant or widespread than was previously believed, and/or those that are not subject to any identifiable threat.

[b]State status of species identified as being of "special interest or concern" for Lincoln and/or Sanders counties and/or the Libby latilong block by Flath (1984).

[c]Kootenai National Forest species status identified as endangered (E), threatened (T), or sensitive (S). (R. Summerfield, KNF Wildlife Biologist)

[d]State status of species identified during a February 1989 Montana Natural Heritage Program computer survey of the Montanore Project study area, including transmission line corridors. Codes are:

S1—Critically imperiled in Montana because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction from the state. (Critically endangered in state.)

S2—Imperiled in Montana because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction from the state. (Endangered in state.)

S3—Rare in Montana (on the order of 20+ occurrence). (Threatened in state.)

S4—Apparently secure in Montana.

S5—Demonstrably secure in Montana.

SU—Possibly in peril in Montana, but status uncertain more information needed

SH—Historically known in Montana, may be rediscovered

[e]Presence

P—Presence confirmed in project study area during the present 1988/89 study.

A—Present adjacent to the project study area during the 1988/89 baseline study.

H—Species documented on the project study area in the last 10 years.

The U.S. Fish and Wildlife Service has determined that of the listed species, only the peregrine falcon, bald eagle and grizzly bear, may occur in the project area (see KNF's *Biological Assessment* in Appendix C). Additionally, there is no evidence of occurrence of either the gray wolf or woodland caribou in the eastern Cabinet Mountains, so they are unlikely to be affected by project activities.

Bald eagle. Bald eagles are most abundant in the vicinity of Libby during fall and spring migrations (November and February), and are more abundant in winter than summer. Bald eagles migrate along Libby Creek and the Fisher River. The KNF has identified the Fisher River as a flight corridor. During winter, they are found along the Kootenai and Clark Fork rivers, at Flathead Lake and at Lake Koocanusa. Some bald eagles winter on Libby Creek upstream from U.S. 2. No suitable nesting habitat occurs in the mine area, and no bald eagles were observed during the baseline surveys. Some may hunt over big game winter ranges in the project area, although none were observed during the baseline surveys.

Grizzly bear. Grizzly bears occur in the Cabinet Mountains and at least one has used the upper portions of Libby and Miller Creeks in recent years. The ranges of a few grizzly bears probably overlap the project area. An ongoing grizzly bear study conducted by Montana Department of Fish, Wildlife, and Parks indicates that up to 15 grizzly bears with an average home range size of 295 square miles inhabit the Cabinet-Yaak ecosystem. The study radio-collared three grizzly bears and the home range of each overlapped the Libby Creek, Ramsey Creek, and upper east fork of Rock Creek drainages.

Historical records indicate the upper drainages of West Fisher Creek, and nearby upper Libby Creek, Ramsey Creek, and East Fork of Rock Creek are a grizzly bear concentration area. All transmission line routes cross grizzly bear habitat identified by the KNF. The least amount of habitat crossed is four miles while the most crossed is six miles.

The Cabinet-Yaak ecosystem is one of three ecosystems targeted for grizzly bear introductions by the grizzly bear recovery plan, which calls for an eventual population of 70 grizzly bears in the ecosystem. The first introduction of one sub-adult female bear occurred during the summer of 1990. A second subadult female was released successfully in the southern part of the Cabinet Mountains in July, 1992.

Grizzly bear food habits and habitat are similar to black bears. Grizzly bears and black bears tend to avoid areas within 1,000 yards of open roads. The Montana Department of Fish, Wildlife, and Parks study indicated grasses and sedges dominated their diet in May, June and October. Forbs were dominant in July. In August the diet shifted to shrubs, primarily huckleberry. Berries are important food for preparing the bears for denning.

Libby Creek, Ramsey Creek and the upper elevations of the East Fork of Rock Creek all have sufficient forage to be important fall feeding areas; Libby Creek has plentiful spring forage. Additional information on grizzly bears is presented in the KNF's *Biological Assessment* presented in Appendix C

Boreal owl. Preferred habitat for boreal owl is spruce-fir forest above 5,000 feet with some nesting occurring in lower elevation spruce-fir and western hemlock habitat. Nesting has been confirmed on the KNF and suitable habitat for the boreal owl is present in the Libby Creek, Ramsey Creek and Poorman Creek drainages. Results of a survey performed in 1989 to determine the presence of the boreal owl in these drainages were inconclusive.

Peregrine falcon. Peregrine falcons occur in the project area and its vicinity as rare migrants (Western Resource Development Corp., 1989d). None were identified during baseline data collection. Suitable nesting habitat is scarce.

Wolverine. Wolverines are a candidate species for listing as threatened or endangered, if sufficient evidence is found to justify the action. They are apparently secure in Montana and are present in

Lincoln County. Wolverine densities have been increasing in northwestern Montana since about 1940 (Western Resources Development Corp., 1989d). Tracks of one wolverine were found in the West Fork of Rock Creek during the baseline study.

Canada lynx. Canada lynx also is a candidate species for the endangered list and is considered sensitive on the KNF. The project area is within a portion of Montana which has some of the highest lynx numbers in the state. Canada lynx apparently are not abundant in the project area. No Canada lynx were observed during the baseline studies. Snowshoe hares are a very important component of lynx diets, but lynx will also eat small mammals and birds. In western Montana, they are usually found in dense, high elevation, coniferous forests. No Canada lynx were observed during the baseline studies although they are known to occur on the KNF.

Other sensitive species. The habitat for a number of sensitive species occurs within the project area. The Coeur d'Alene salamander has been found in tributaries to Libby Creek and Bear Creek. Some of these populations are along the proposed access road. Potential habitat is widespread throughout the Libby Creek drainage and its tributaries. Suitable habitat for the harlequin duck occurs on both Libby and Ramsey creeks. Harlequin ducks have been observed on the west side of the Cabinets in Rock Creek. During the baseline surveys, droppings characteristic of waterfowl were found in suitable habitat on Libby Creek in 1989, but no harlequin ducks were observed. No sign of harlequin ducks were observed in Ramsey Creek (Western Resource Development Corp., 1989d). Although not sighted, it is possible harlequin ducks occur in Libby Creek.

Suitable flammulated owl habitat is abundant along the transmission line corridor, particularly in Miller Creek, but flammulated owl presence has not been confirmed there (A. Bratkovich, KNF Biologist, pers. comm. w/ P. Davis, March 20, 1992).

On the KNF, black-backed woodpeckers prefer lodgepole pine stands with insect infestations or old burns. About 25 acres of lodgepole habitat occurs in the tailings impoundment area. No black-backed woodpeckers were observed during the baseline surveys. The Townsend's big-eared bat roosts in caves and mines. It is suspected to occur in Lincoln County but its presence has not been confirmed. No Townsend's big-eared bats were observed during the baseline surveys for the Montanore project nor during surveys for ASARCO's Rock Creek project (Western Resource Development Corp., 1989d).

Fishers have recently been reintroduced into the Cabinets on the west side with subsequent reintroductions on both sides of the Cabinets. Those individuals introduced on the west side have been followed in a radio monitoring study. One of these radio-collared animals was present in Libby and Ramsey creeks between June and August 1990 when its radio apparently failed. All of the locations except one were in the upper reaches of the creeks near the exploration adit and the proposed plant site. A total of 110 fishers have been introduced in the Cabinets and survival has been estimated at approximately 50 percent, indicating at least 50 fishers are present (Sutherland, K., M.S. Candidate, University of Montana, Missoula, personal communication, April 3, 1992).

Northern bog lemmings are found in wet alpine and subalpine meadows with lush vegetation. Sedge-alder bogs on the edge of or within spruce-fir forest are preferred (Western Resource Development Corp., 1989d). The northern bog lemming was found during the summer of 1992 on the KNF, which is at the southern limit of the species' range. No northern bog lemmings were found during the baseline surveys, although suitable habitat was found on Libby Creek near the exploration adit and on Ramsey Creek near the proposed plant site.

OLD GROWTH HABITAT

Old growth provides important habitat to a wide variety of wildlife species. On the KNF, more than 50 species prefer old growth habitat. This preference

is in part due to the diversity within old growth habitats, with multiple vegetation layers, a variety of tree species, and occasional open areas where trees have fallen. Another important component of old growth is snags, which provide habitat for cavity nesting birds.

As wildlife habitat, the size of old growth stands is important. At least 50 acres are needed to support nesting pileated woodpeckers (McClelland, 1979). Stands of 100 acres are recommended in the Forest Plan (Kootenai National Forest, 1987). Smaller stands in proximate clusters, especially when surrounded by mature trees also may be suitable habitat. Islands of old growth more than a mile distant from other old growth stands or surrounded by timber harvest areas may be of limited suitability for some species. In other words, the overall mosaic of old growth habitat is an important factor in determining the overall value as wildlife habitat.

The pileated woodpecker is the Management Indicator Species for old growth habitat in the KNF. Pileated woodpeckers feed primarily on carpenter ants found in dead and decaying wood (Bull, 1987 and Warren, 1990). Pileated woodpeckers usually nest in snags. They also serve the function of excavating cavities for other non-excavating, hole-nesting species of woodpeckers, songbirds, owls, and squirrels (McClelland, 1979). Pileated woodpeckers were the second most common woodpecker observed during the baseline studies, using all timbered habitat types except riparian. Although breeding was not confirmed, there were strong suggestions it occurred in the project area during 1988. Breeding has been confirmed elsewhere on the KNF (Western Resource and Development, 1989d). Other species found in KNF old growth include goshawk, barred owl, great gray owl, brown creeper, and pine marten.

Field-verified stands of old growth habitat in the Libby Creek timber compartment are shown in Figure 3-10. Field-verified stands of old growth habitat in the Horse Mountain management compartment are shown in Figure 3-11.

A requirement of the KNF Forest Plan is to protect a minimum of 10 percent old growth habitat below a 5,500-foot elevation in each timber compartment. Old growth habitat is protected primarily for the benefit of old growth dependent wildlife species. In the project area, protected old growth habitat is found in Management Areas 2, 13, and 18. Old growth habitat also occurs in other management areas which are primarily managed for resources such as timber production; old growth habitat in Management Areas other than 2, 13, and 18 is not protected. Management of protected old growth habitat is further discussed under the *Kootenai National Forest Management* section. Under existing conditions, the goal of 10 percent protected old growth habitat has been achieved for both the Libby Creek and Horse Mountain timber compartments (Table 3-25).

Table 3-25. Protected and unprotected old growth habitat in project area.

Timber compartment	Area below 5,500 feet (acres)	Protected old growth required by Forest Plan (acres)	Current status: Protected old growth† (acres)	Current status: Protected old growth† (%)	Current status: Unprotected old growth (acres)	Current status: Total old growth (acres)	Current status: Total old growth (%)
Libby Creek	16,168	1,619	1,839	11.4	607	2,446	15
Horse Mountain	18,203	1,820	1,932	10.6	106	2,038	11

Source: Kootenai National Forest, Libby Ranger District, 1991.
†Old growth occurring in Management Areas 2, 13, and 18 where timber harvesting is restricted

VEGETATION

The project area vegetation is characteristic of the Northern Rockies. Most of the project area is covered by a coniferous forest comprised of seven dominant tree species. Logging has produced clearcuts on nearly a quarter the mine area. Coniferous forest and clearcuts comprise nearly 90 percent of the mine area. Shrub-dominated communities occur on steeper slopes and at higher elevations. Communities adapted to more moist sites, dominated by Engelmann spruce, occur along the major streams.

Vegetation of the transmission line corridors resembles that of the mine area. Proportions of vegetation types crossed vary little among the three routes: 67 to 78 percent coniferous forest; 17 to 29 percent clearcut, and 4 percent riparian.

Vegetation Types

Six vegetation types have been identified in the project area—Coniferous Forest, Clearcut, Shrubfields, Wetlands, Riparian, and Agricultural Land.

Coniferous forest. This type is the largest vegetation type in the project area, comprising about 50 percent of the area. Timber harvesting occurs in this vegetation type. Six predominant tree species occur in the type—western red cedar, western larch, western hemlock, grand fir, Engelmann spruce, and lodgepole pine. Western red cedar and western hemlock are the dominant tree species in the transmission line corridor.

The KNF has identified scattered stands of coniferous forest in the project area as "old growth." It manages these stands to maintain forest diversity and for wildlife habitat. Dense canopy cover (100 percent or more), large diameter trees, and sparse shrub and forb growth typify old growth stands. All transmission line alternatives may cross areas of old growth timber.

With 129 identified species, this is the most diverse vegetation type in the project area. Western hemlock provides the highest cover and grand fir has the highest density in the mine area. Out of a 32.1 thousand board feet per acre total, Western hemlock provides nearly half the timber volume (15.7 thousand board feet per acre). Grand fir and Douglas fir provide about ten percent of the total board volume. Black cottonwood has the highest average diameter of 34 inches. Most trees are considerably smaller; western larch has a diameter of nearly 11 inches and Douglas-fir has an average diameter of nearly 9 inches.

A variety of shrubs and forbs occur in this type, with Rocky Mountain maple, Pacific yew, sitka alder, and huckleberry being common shrubs, and tiarella, queencup beadlily, heartleaf arnica, and western goldthread common forbs. Nineteen grasses are found in the type, but provide little cover. Shrub densities are high, at over 6,600 stems per acre. The most common grasses include reed mannagrass occurring on wetter sites, and pinegrass in drier areas.

Clearcut. Clearcut areas are scattered throughout the project area; most logging occurred between 10 and 20 years ago. Clearcuts have a species diversity similar to the Coniferous Forest type. Western red cedar, western larch, Douglas-fir, Engelmann spruce, and lodgepole pine are the most abundant tree species in the Clearcut type. Total tree density is 916 trees per acre. Engelmann spruce, black cottonwood, and western white pine have the highest reproduction rates; total tree reproduction rate is about 2,200 trees per acre. Most trees are small with an average diameter for most species less than two inches.

Shrubs are abundant in the Clearcut type, taking advantage of the more open canopy. Over 15,000 stems per acre occur in this type, and shrubs provide about 25 percent of the relative cover. Common shrubs include white spirea, pachistima, Sitka alder, huckleberry, and snowberry.

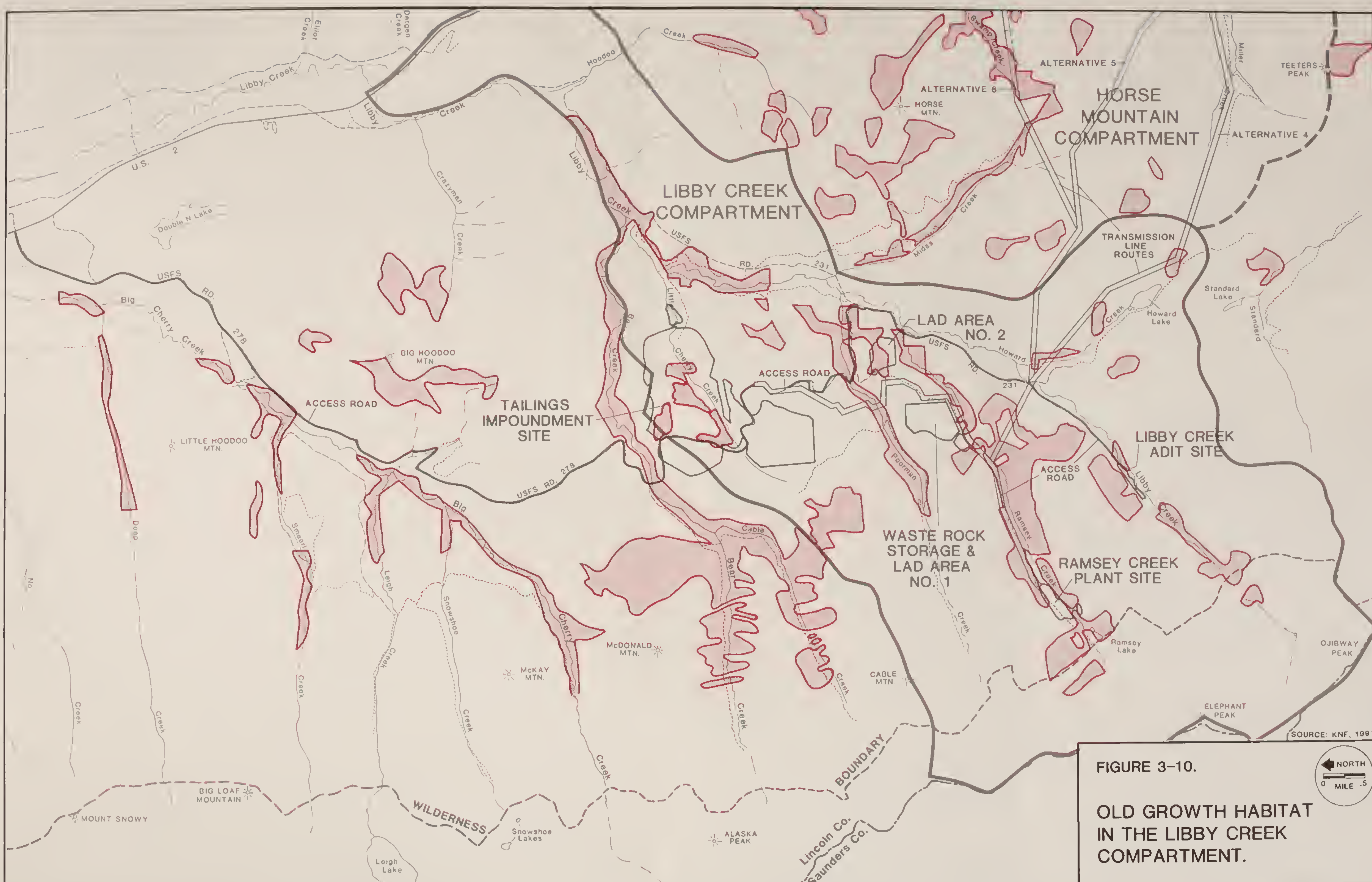


FIGURE 3-10.

OLD GROWTH HABITAT IN THE LIBBY CREEK COMPARTMENT.

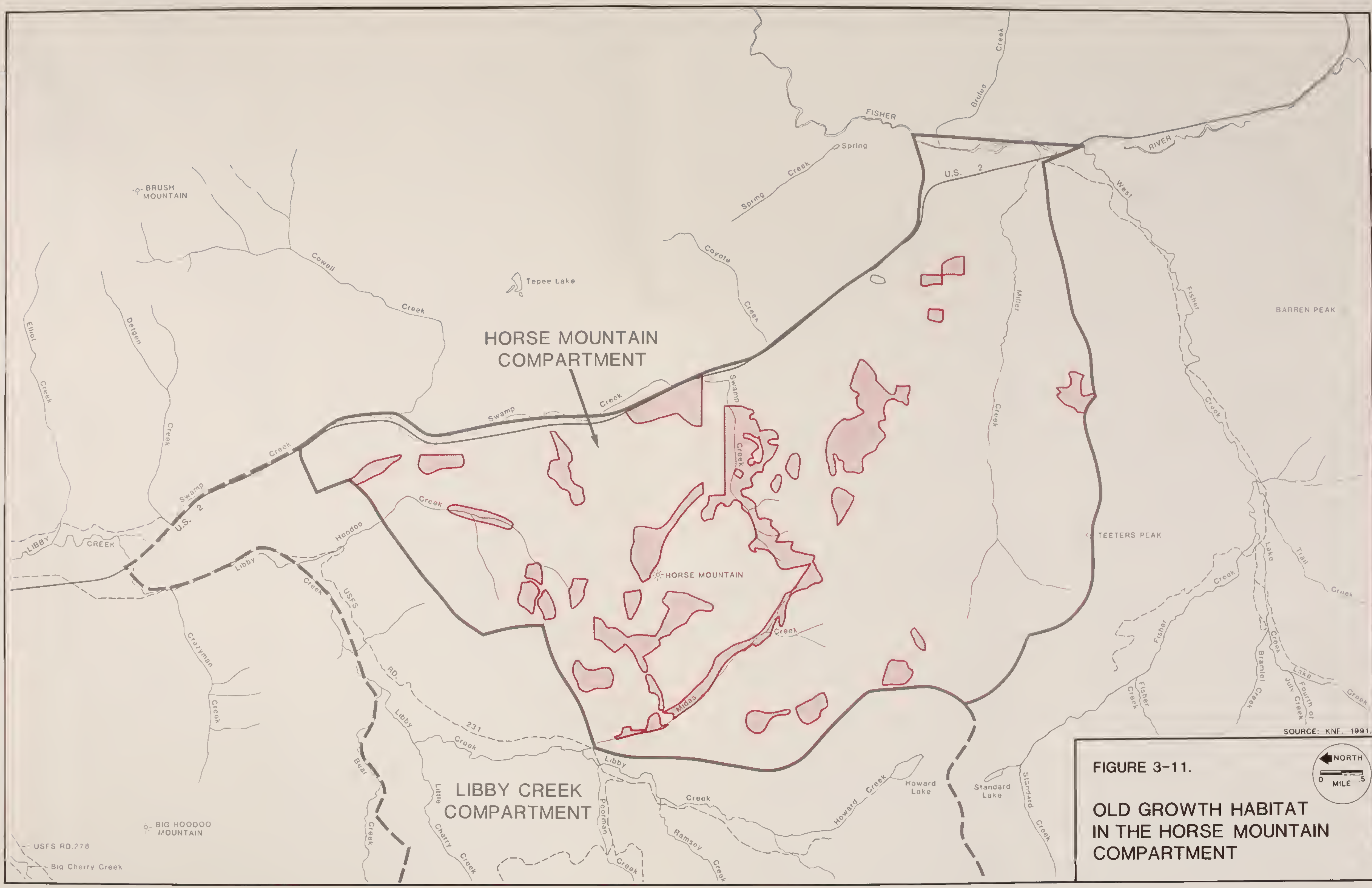


FIGURE 3-11.

OLD GROWTH HABITAT IN THE HORSE MOUNTAIN COMPARTMENT

Grasses provide 17 percent and forbs provide 24 percent of the cover in clearcut and coniferous forest areas. Baseline studies identified 23 perennial grasses and 51 perennial forbs. Grasses include pinegrass, northwest sedge, western fescue, and purple reedgrass; dominant forbs are Virginia strawberry, fireweed, orange hawkweed, and beargrass.

Shrubfields. Shrubfields occur in steep avalanche chutes in the Libby Creek and Ramsey Creek areas. Comprising of 26 shrubs, the type is diverse and provides cover and food for big game species including the grizzly bear. Major shrub species are thimbleberry, huckleberry, pachistima, red raspberry, and Sitka alder. Shrub density, at 17,600 stems per acre, is the highest of the six identified vegetation types in the study area. Trees invading on shrubfields include subalpine fir, aspen and grand fir.

Beargrass is the most abundant of the 26 perennial forbs present. Other common perennial forbs include green false hellebore, hooker fairybell, starry Solomon's seal, and cow parsnip. Grasses provide about 10 percent of the relative cover, nearly half of which is bluejoint reedgrass.

Wetlands. Wetlands occur along drainages in the tailings impoundment area and the transmission line corridors. Wetlands have been discussed in the *Wetlands and Waters of the United States* section.

Riparian. The Fisher River is bordered by a mixture of conifers and mature cottonwoods. The cottonwoods grow in scattered clumps, reaching diameters of over 20 inches and heights of 60 feet. Scattered old cottonwoods have grown to 80 feet tall and 48 inches in diameter along upper Libby Creek. Further downstream, flooding has created conditions that favor dense stands of saplings and pole-sized cottonwoods. Riparian shrubs include Sitka alder and snowberry. All transmission line routes cross the Fisher River's riparian zone; the two Miller Creek routes also contact Miller Creek riparian zone.

Agricultural land. At lower elevations along the eastern edge of the project area, there are several scattered farms along U.S. 2. All cultivated farmlands are along the highway. The lands used for agriculture range in size from 10 acres to almost 60 acres.

Threatened, Endangered, or Sensitive Species

No threatened or endangered plant species have been found within the project area. A relatively large population of the northern beechfern (*Thelypteris phegopteris*) has been found along Little Cherry Creek, within the proposed tailings impoundment site. The northern beechfern has been identified by the Regional Forester as a sensitive species due to a combination of rarity and limited distribution within the Northern Region, and potential habitat loss. The northern beechfern is classified by the Montana Natural Heritage Program as secure globally, but imperiled in Montana because of rarity within the state. Outside of the Northern Region of the USFS, the northern beechfern is found from Alaska to Washington and Saskatchewan and from Labrador to Ontario, south into parts of the eastern United States. Habitat requirements of dense old growth cedar, high water table, soils with a thick organic surface, and stable braiding streams are limited on the KNF.

Montana is located on the periphery of northern beechfern's range. As of September, 1992, there are seven known sites of northern beechfern in Montana, six of which are located on the KNF. Five of these sites (of which Little Cherry Creek is one) have large populations. The other three are small in size. Nine additional known populations of northern beechfern have been found on the Idaho Panhandle National Forest. The KNF is presently surveying additional streams on the Forest. Four of the six known populations on the KNF have been located during this continuing survey.

Wool-grass (*Scirpus cyperinus*) also is a USFS-designated sensitive species. Wool-grass grows in wetlands in the Bear Creek drainage along Libby Creek, and in a wet roadside ditch between Poorman Creek and Little Cherry Creek. A large population with thousands of individuals grows in a large

wetland on Libby Creek, near the confluence with Howard Creek. This population is outside the proposed mine disturbance areas, but would be near the proposed powerline corridor. Several individual plants have been found in moist areas in the Little Cherry Creek and Bear Creek drainages. Sensitive plant species are discussed in greater detail in the *Biological Evaluation for Plant Species*, on file with the KNF.

Noxious Weeds

The District Weed Control Board of Lincoln County has identified noxious weeds occurring within its jurisdiction. Three species from this list—Canada thistle, St. Johnswort, and spotted knapweed—were identified in the project area. Spotted knapweed is found along the Fisher River, adjacent to U.S. 2, and most roads in the project area. It reaches highest densities where low soil moisture or road maintenance prevents the establishment of competing plants. Knapweed is thought to affect big game animals by reducing available forage. Canada thistle occurs along roadsides and rapidly invades clearcuts following logging. St. Johnswort, typically found along roadsides, is unpalatable to livestock and big game animals, and can adversely affect livestock.

SOILS

Four geomorphic processes, colluvial (movement downhill as a result of gravity), fluvial (movement by flowing water), lacustrine (movement or deposition in lakes) and glacial (movement by glaciers) have influenced soils development in the project area. Soils forming in glacial or colluvial material are typically high in rock fragments. Soils forming in lacustrine sediments, deposited along the Fisher River, Miller Creek, West Fisher Creek and Libby Creek, are typically higher in silts and clays with few rock fragments. Blanketing much of the project area soils is a thin mantle of fine volcanic ash.

Soil Types

In the project area, soils can be placed into four general groups, based on the type of parent material in which they formed. The four groups, described in the following sections, are colluvial/glacial, colluvial/residual, alluvial/lacustrine, and rock outcrop/residual.

Colluvial/glacial. The colluvial/glacial soils occur on moderately to steeply sloping, glaciated valley sideslopes primarily in the tailings impoundment area and along the access road. The soils are deep, have a high content of rock fragments, and vary in texture. Organic matter content is high (two to five percent) in the surface layers and is typically less than one percent in subsoil layers. Soil salinity levels are characteristically low.

A typical soil profile of this group consists of a thin (2 to 14 inches) surface layer overlying subsoil layers varying in texture and in rock fragments. Surface soils are silt loams, having a coarse to moderately fine texture. The subsoils range widely in texture, from coarse (15 percent clay) to fine (60 percent clay), depending on the parent material. Rock fragment content is low in the ash-influenced surface layer and generally increases with depth. Acidity is also quite variable, ranging in pH from 4.7 to 7.5. More acidic soil pHs (5 to 6) are typical.

Soils on steep mountain sideslopes and avalanche chutes near the plant site are also in the colluvial/glacial soils group. These soils occur primarily along Ramsey Creek near the proposed plant site location and along Libby Creek below the Libby Creek adit site. These soils have a thin, ash-influenced layer typically with less than 15 percent rock fragments. Below the surface layer are coarse-textured layers with more than 35 percent rock fragments. These soils are acid throughout their profiles, with pH values typically ranging between 5 and 6.

Mixed coniferous forest and clearcuts are the primary vegetation types found on the colluvial/glacial soils

group. A shrub-dominated community, comprised primarily of huckleberry and thimbleberry, occurs on the soils found in the avalanche chutes.

Colluvial/residual. The colluvial/residual soils group is found on steep slopes and bedrock-controlled ridges in the tailings impoundment and land application disposal areas, and along the transmission line route. On steeper slopes, colluvial processes have affected the development of these soils. As with most soils in the mine area, the soils in the residual soils group have a thin ash-influenced layer. Rock fragment content in the surface layer is generally low and very high in the subsoil layer. Values for pH are generally acidic, ranging between 5 and 6. This soil group supports a coniferous forest vegetation type.

Alluvial/lacustrine. Soils in this group have formed in alluvium, lacustrine deposits and glacial outwash. Narrow areas of alluvial deposits occur throughout the project area. Lacustrine deposits occur along the Fisher River, Miller Creek, Schrieber Creek and Little Cherry Creek. Typical surface textures for soils in this group are silt loam, and subsoil textures vary from coarse to fine. Rock fragment content is low in soils formed in the lacustrine deposits, and variable in the alluvial deposits. These soils are acidic throughout their profiles, with pH values typically ranging between 5 and 6.

Soils forming in alluvial deposits occur along all the project area streams. Depth to water is variable, with some soils saturated throughout most of the year. Soil texture and rock fragment content are variable. The soils are slightly acid, with pH values ranging between 6 and 7. This soil group supports a coniferous forest vegetation type.

Rock outcrop/residual. This group primarily consists of areas with exposed bedrock and little soil development. These areas are typically on ridges and glaciated valley sideslopes at higher elevations near the plant site and along the transmission line corridor. Where soils exist, they are thin (<20 inches) and high in rock fragments. This group supports a variety of alpine and subalpine vegetation.

Suitability for Reclamation

The surface layers of the mine area soils are generally suitable for topsoil salvage and replacement. Decisions regarding soil suitability and the necessity for soil salvage along the transmission line would be made in the field after road locations have been finalized. Organic matter levels in surface soils are generally moderate to high, and pH values range between 4.9 and 6.6. Because of the ash influence, the surface layers are typically coarse textured and have a high water holding capacity relative to the coarse soil texture. Surface soils typically have less than 15 percent rock fragments. Subsoil layers are more variable in texture, pH, and rock fragment content.

The primary limitation to soil suitability for reclamation is rock fragment content (Table 3-26). Soils with more than 50 percent rock fragments are generally considered unsuitable. Some soils in the tailings impoundment area with rock fragment content up to 60 percent are proposed for salvage. A high water table would preclude salvage of some soils.

LAND USE

Most lands in the project area are managed by the KNF. Private land occurs along Libby Creek (patented mining claims), Miller Creek (forest industry and private), Fisher River (forest industry and private), and around Schrieber Lake (private). The KNF manages public land for multiple use benefits, including wood products, recreation, range, wildlife, mineral development and wilderness. Forest industry land is primarily managed for wood products, and private lands are managed to satisfy individual landowner objectives.

The National Forest lands of the Libby District provide approximately 25 million board feet (mmbf) of timber annually. There are two forest service timber sales under contract in the project area; on the Donkey Face Salvage timber sale is active. Timber

Table 3-26. Soil suitability depths for mine area soils.

——Soil—— group type	Suitable depth (in.)	Limitation
Colluvial/residual		
Andic Dystrochrepts, moderately deep	11	Rock fragments
Andic Dystrochrepts, deep	9	Rock fragments
Colluvial/glacial		
Andic Cryochrepts	29	Rock fragments
Andic Cryochrepts	20	Rock fragments
Typic Cryochrepts/ Cryumbrepts	0	Rock fragments; surficial boulders
Typic Cryorthents	0	Rock fragments
Typic Glossoboralfs	33	Rock fragments
Typic Paleboralfs	24	Rock fragments
Alluvial/lacustrine		
Andic Dystrochrepts	65	Rock fragments
Andic Dystrochrepts	9	Rock fragments
Andic Dystrochrepts	9	Rock fragments; pH, texture
Typic Humaquepts	15	High water table
Cumulic Humaquepts	9	High water table

Source: Noranda Minerals Corp. 1989a. V. 1, pp. I-81*ff*.

harvest activity also occurs on forest industry lands, providing about 115 million board feet annually (B. Caldwell, Supervisor, Libby Field Office, DSL, pers. comm.). This harvest level is expected to decline within 10 years.

Logging has taken place along Libby Creek adjacent to the private land since the late 1960s. Timber was harvested from upper Libby Creek and Ramsey Creek following the Libby Creek Road extension in the mid-1970s, resulting in a number of clearcut areas within the project area. Logging continues in the area, with new harvests in lower Ramsey Creek, upper Midas Creek, and much of Miller Creek. Champion International has clearcut harvested several tracts of private land on lower Miller Creek and along Fisher River.

There is one livestock grazing allotment in the project area near the Libby Creek and Midas Creek confluence. The permit allows 30 head of livestock to be grazed from May 16 to October 16.

Some mineral activity occurs in the project area. It includes small placer operations on Libby and Big Cherry creeks, small lode mining operations along Libby Creek, Snowshoe Creek, at the headwaters of the West Fisher, and in the Prospect Hill area four miles south of Libby. Between 10 and 20 mineral operators do some form of work along the east face of the Cabinet Mountains each year.

The project area is used extensively for recreation (discussed in the *Recreation* section). A few private residences are located near U.S. 2, particularly near the Libby Creek Road, the Bear Creek Road, the Fisher River, and Schrieber Lake.

KOOTENAI NATIONAL FOREST MANAGEMENT DIRECTION

Management direction for the Kootenai National Forest is given in the Forest Plan (Kootenai National Forest, 1987). This document provides forest-wide management goals, objectives and standards, and goals and standards for sub-units of the KNF referred to as Management Areas.

Forest-wide Goals, Objectives, and Standards

Goals. Goals provide information on the long-range management intent. The objectives and standards of both the forest as a whole and individual Management Areas must support the goals. All activities conducted on the KNF must contribute to the realization of the goals. The goal for mineral development, discussed under Goal #11 is—"encourage responsible development of mineral resources in a manner that recognizes national and local needs and provides for economically and

environmentally sound exploration, extraction, and reclamation."

The Forest Plan also establishes a goal of providing a sustained yield of timber volume responsive to market demands and supportive of a stable base of economic growth in the dependent geographic area.

Goals for the wildlife resource include (1) maintaining and enhancing sufficient habitat to facilitate recovery of threatened and endangered species; (2) maintaining diverse age classes of vegetation to support viable populations of existing vertebrate species, including old growth dependent species; (3) managing for sufficient snags (dead standing trees) to maintain viable populations of snag-dependent species; and (4) maintaining big game and fisheries habitat.

For water quality, the Forest Plan establishes a goal of meeting or exceeding State water quality standards. To achieve this goal, forest-wide objectives for water quality require application of practicable mitigation measures, including those identified in the Soil and Water Conservation Handbook.

Objectives. Mineral exploration and development may occur on nearly all areas of the KNF; areas withdrawn from future mineral entry include the Cabinet Mountains Wilderness and developed recreation sites. Noranda established valid mining claims for mineral resources inside the wilderness prior to the legislatively-mandated withdrawal date. The objective concerning minerals requires consideration of other resources during mineral exploration and development.

Objectives for facility corridors, such as a transmission line corridor, are discussed under Corridors in the Forest Plan. The objectives establish corridor exclusion, avoidance, and window areas to assist in corridor siting. Criteria for these areas are outline in Appendix 15, Corridor Criteria, of the Forest Plan.

Goals and objectives for cultural resources, recreation, visual resources, air quality, road management, and riparian areas have also been established and are described in the Forest Plan.

Standards. The minerals standard requires the KNF to "recognize the value and importance of the mineral resource in management activities." Road access for mineral development "will be allowed if it is the next logical step in the development of the mineral resource," subject to the restriction of various laws, such as the Wilderness Act and the Endangered Species Act. Plans of Operations for mineral development must include "reasonable and justified" requirements designed to minimize environmental impacts. The KNF is required to provide guidance to the mineral industry to assist in developing environmentally sound mining and reclamation plans.

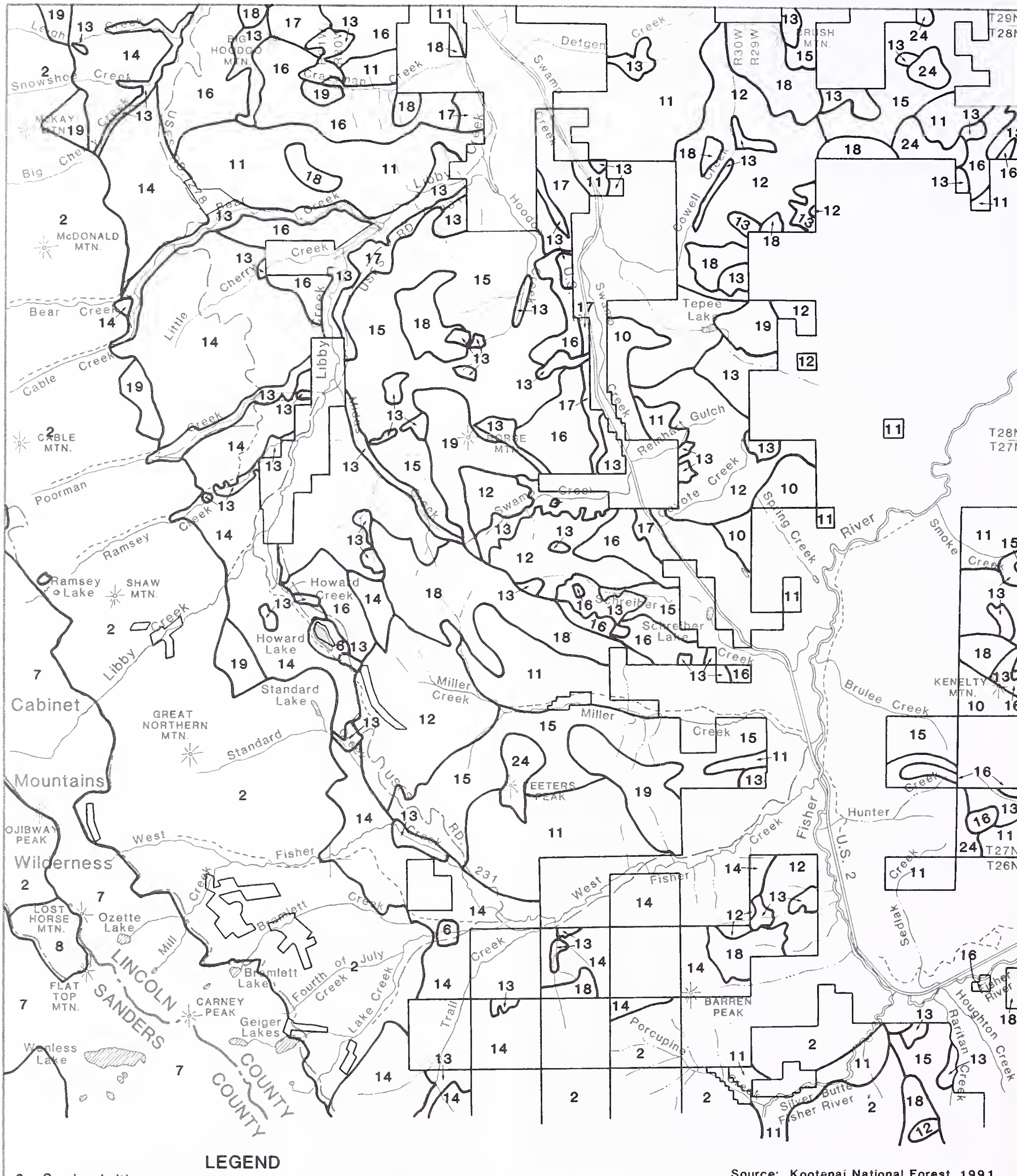
Management Area Goals and Standards

The Forest Plan also includes goals and standards for 23 Management Areas (MAs), which are geographic sub-units of the KNF with different management emphases. The combination of these Management Area emphases are intended to achieve the forest-wide goals and objectives.

Figure 3-12 shows the distribution of existing Management Areas within the proposed project area. This figure has been revised to reflect needed corrections in land ownership and some MA boundaries. The KNF has corrected some old growth habitat boundaries after completing the necessary on-the-ground validation. Brief descriptions of the MAs which occur near the project area are given in the following sections. The standards are summarized in Table 3-27.

For all MAs discussed in the following sections, the standard for minerals refer to the forest-wide standards described in the previous section. In all MAs, soil and water conservations practices must be implemented for all developmental activities.

Semi-primitive Non-motorized Recreation (MA 2). This MA offers roadless recreation opportunities. The goal of this MA is to provide for the protection and enhancement of areas for roadless recreation use



LEGEND

- 2 Semi-primitive Non-motorized Recreation (Unsuitable Timberland)
- 6 Developed Recreation Sites (Unsuitable Timberland)
- 7 Existing Wilderness (Unsuitable Timberland)
- 8 Recommended Wilderness (Unsuitable Timberland)
- 10 Big-Game Use (Unsuitable Timberland)
- 11 Big-Game Winter Range (Suitable Timberland)
- 12 Big-Game Summer Range (Suitable Timberland)
- 13 Designated Old-Growth Timber (Unsuitable Timberland)
- 14 Grizzly Habitat Management (Suitable Timberland)
- 15 Timber Production (Suitable Timberland)
- 16 Timber with Viewing (Suitable Timberland)
- 17 Viewing with Timber (Suitable Timberland)
- 18 Regeneration Problem Areas (Unsuitable Timberland)
- 19 Steep Lands (Unsuitable Timberland)
- 24 Low Productivity Areas (Unsuitable Timberland)

Note: Areas Not Labeled Are Not KNF Lands

FIGURE 3-12.

EXISTING KNF MANAGEMENT AREAS IN PROJECT AREA

Table 3-27. Summary of relevant standards in selected Management Areas on the KNF.

Management Area	Locatable mineral development[†]	Powerline corridors	Lands & facility occupancy	Motorized access	Wildlife	Logging	Visual Quality Objective	Road development
Semi-primitive non-motorized recreation (MA 2)	Forest-wide standards apply	Avoidance area	Frequently used facilities normally prohibited	Closed, except for limited exceptions	Grizzly habitat	Unsuitable	Retention	Generally prohibited; existing roads may be used for mineral development on a case-by-case basis. New roads permitted when justified by mineral information
Developed recreation sites (MA 6)	Restricted	Avoidance area	Permitted	Restricted	Provide habitat	Unsuitable	Partial retention	Restricted
Existing wilderness (MA 7)	Prohibited except for valid rights	Exclusion	Prohibited	Prohibited	Emphasize grizzly habitat	Prohibited	Perservation	Prohibited, except for mineral development on valid existing rights
Big game winter range (MA 11)	Forest-wide standards apply	Permitted	Permitted with winter restrictions	Closed during winter	Maintain openings for big game	Suitable	See footnotes [§,¶]	Allowed
Big game summer range (MA 12)	Forest-wide standards apply	Avoidance area in grizzly habitats	Frequently used facilities normally prohibited	Roads generally closed	Big game and grizzly habitat	Suitable	See footnote [§]	Restricted
Designated old growth timber (MA 13)	Forest-wide standards apply	Avoidance area	Restricted	Prohibited during summer/fall	Grizzly bear and old growth species habitat	Unsuitable	See footnotes [§,¶]	Restricted
Grizzly habitat (MA 14)	Forest-wide standards apply	Avoidance area	Generally prohibited	Allowed, with restrictions	Grizzly habitat	Suitable	See footnote [§]	Allowed, outside grizzly use times
Timber production (MA 15)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Maximum modification	Allowed
Timber with viewing (MA 16)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Modification	Allowed
Viewing with timber (MA 17)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Partial retention	Allowed
Revegetation problem areas (MA 18)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Unsuitable	See footnote [§]	Very restricted
Steep lands (MA 19)	Forest-wide standards apply	Avoidance area	Generally prohibited	Restricted	Provide habitat	Unsuitable	See footnote [§]	Very restricted

Source: Kootenai National Forest. 1987.
[†]The Montanore Project would be a "locatable mineral development"
[§]Maximum modification in areas of low visual significance, modification in areas of moderate visual signficance, and partial retention in areas of high visual significance.
[¶]Unless infeasible when attempting to meet the goals of the Management Area.

and to provide for wildlife management where specific wildlife values are high. In some areas, this MA provides habitat that will contribute to grizzly bear recovery. Some roads are currently open to some form of motorized recreational use, including snowmobiles. Roads may be justified for mineral activities. Trails are normally closed to all motorized vehicles. This MA is classified as a corridor avoidance area (Forest Plan, pp. III-2 to III-7).

Developed Recreation Sites. This MA includes developed campgrounds, picnic areas, boat ramps, and other developed recreation sites. Areas are usually associated with water features such as lakes, reservoirs, and streams. The management goal is to provide safe and sanitary developed recreation in a setting that is pleasant and visually attractive. Seasonal use restrictions may also be applied if appropriate in areas to avoid wildlife conflicts. This MA is usually withdrawn from mineral development, and is classified as a corridor avoidance area. (Forest Plan, pp. III-17 to III-20.)

Existing Wilderness (MA 7). This MA is composed entirely of the Cabinet Mountains Wilderness. The wilderness is managed in accordance with the Wilderness Act of 1964. Goals include maintaining natural conditions, providing opportunity for solitude and primitive forms of recreation, and encouraging grizzly bear recovery. Habitat for other wildlife species is preserved, although habitat enhancement projects are not permitted. Valid mineral rights are recognized and these rights are managed in accordance with the Wilderness Act and other applicable laws and regulations. Road construction is not permitted, except to provide reasonable access to valid mineral rights. The MA is classified as a corridor exclusion area. (Forest Plan, pp. III-21 to III-25.)

Big Game Winter Range/Timber (MA 11). The Forest Plan goal for this MA is maintaining or enhancing the winter range habitat effectiveness for big game species while also producing a programmed yield of timber, and maintaining the viewing resource in areas of high visual significance. The goals and standards concentrate on protection of important wintering areas, and providing optimum habitat for elk, mule deer, whitetail deer, moose, sheep and goats for winter survival. Corridors are permitted. (Forest Plan, pp. III-43 to III-47.)

Big Game Summer Range/Timber (MA 12). This MA emphasizes maintenance or enhancement of summer and fall big game habitat while producing a programmed yield of timber. The goals and standards focus on providing big game habitat diversity for black and grizzly bear, elk, moose, mule deer and whitetail deer. Timber production will be maintained through cultural treatments and regeneration harvest designed to reduce the frequency of entries. Facilities which require frequent maintenance or occupancy are normally not allowed. This MA is a corridor avoidance area in areas important to grizzly bear use. (Forest Plan, pp. III-48 to III-50.)

Designated Old Growth Timber (MA 13). The Forest Plan goal for this MA is to provide the special habitat necessary for old growth-dependent wildlife on a minimum of 10 percent of each major drainage, and in units that represent the major habitat types and tree species of each drainage. The goals and standards emphasize providing diverse, high quality, year-round habitat for old growth-dependent wildlife (usually other than big game) by relying on natural processes of stand aging, decadence and eventual deterioration. This MA is classified as a corridor avoidance area. (Forest Plan, pp. III-54 to III-57.)

Grizzly Habitat/Timber (MA 14). This MA is designed to maintain or enhance grizzly bear habitat, reduce grizzly/human conflicts, assist in the recovery of the grizzly bear, realize a programmed level of timber production, and provide for the maintenance or enhancement of other wildlife, especially big game. Grizzly habitat components that are identified will be maintained or enhanced and key components such as wallows, wet meadows and bogs will be mapped and managed as riparian areas. This MA is

classified as a corridor avoidance area. (Forest Plan, pp. III-58 to III-63.)

Timber Production (MA 15). The Forest Plan goal for this MA is to focus upon timber production using various standard silvicultural practices while providing for other resource values such as soil, air, water, wildlife, recreation and forage for domestic livestock. This MA has standards and guidelines for providing optimum timber production by ensuring full stocking through natural and artificial regeneration, and maintaining optimal volume growth through stocking control by thinning. Most roads are available for motorized recreation. Transmission line corridors are permitted. (Forest Plan, pp. III-64 to III-67.)

Timber with Viewing (MA 16). This MA is characterized by productive forest land that has moderate viewing sensitivity. There are no identified habitats for threatened or endangered species. The goals of this MA are to produce timber while providing for a pleasing view. Most roads are available for motorized recreation. Transmission line corridors are permitted. (Forest Plan, pp. III-69 to III-73.)

Viewing with Timber (MA 17). This MA emphasizes maintenance and enhancement of a natural-appearing landscape to provide a pleasing view, while producing a programmed volume of timber. The goals and standards focus on providing landscapes that are pleasing to the viewer, while producing a level of timber production that is compatible with visual resource protection. Roads are generally located so they are not visible from major travel corridors. Transmission line corridors are permitted. (Forest Plan, pp. III-74 to III-78.)

Regeneration Problem Areas (MA 18). This MA occurs on areas of slopes in excess of 40 percent where timber productivity is moderate to high. This MA is distinguished by the existence of competing vegetation that makes it difficult to establish coniferous regeneration after timber harvest. The goals of this MA are to maintain the existing coniferous vegetation until techniques and practices are available to ensure that timber can be harvested and the area adequately regenerated within five years of harvest, and to maintain viable populations of existing native wildlife species. Because of the sensitivity of this MA, water quality and soil erosion will be monitored as part of any surface disturbance activity. Transmission line corridors are permitted. (Forest Plan, pp. III-79 to III-82.)

Steep Lands (MA 19). The Forest Plan goal for this MA is to ensure soil stability and water quality by maintaining the vegetation in a healthy condition and by minimizing surface disturbance. This MA has goals and standards that concentrate on the protection of soil and water quality by restrictions on harvest methods and other site disturbance activities. Both water quality and soil erosion must be monitored during these activities. The MA is classified as a corridor avoidance area. (Forest Plan, pp. III-83 to III-86.)

Riparian Areas. The Forest Plan goals and standards for these areas are intended to supplement the goals and standards that apply to the Management Areas where riparian areas are found. The goal for riparian area management is to manage the vegetation to protect soil and water resources and to provide high quality water, habitat for indigenous fish and wildlife species (including grizzly bear), timber for harvest, water oriented recreation, and a pleasing view. Standards for these areas concentrate on meeting these goals by minimizing simultaneous openings on both sides of streams, encouraging recreational developments outside of riparian areas, following wildlife habitat guidelines during development of openings, and restricting the use of site-disturbing equipment. (Forest Plan, pp. II-28 to II-34.)

VISUAL RESOURCES

The KNF manages visual resources according to Visual Quality Objectives established in the Forest Plan (Kootenai National Forest, 1987) for each defined Management Area. Management Areas in the

project area are described under the *Land Use* section and shown in Figure 3-9. Visual quality objectives by Management Area are shown in Table 3-27 in the *Land Use* section. There are five possible visual quality objectives, all of which occur in the project area. They are—

- *Preservation*–managed for ecological changes only;
- *Retention*–managed for natural-appearing landscapes;
- *Partial retention*–managed for slightly modified landscapes;
- *Modification*–managed for modified landscapes; and
- *Maximum modification*–managed for greatly modified landscapes.

Viewing significance (see *Glossary* section) determines the Visual Quality Objective for some Management Areas. For example in Management Area 13, maximum modification is the objective where viewing significance is low and partial retention is the objective where the viewing significance is high. With the exception of along portions of U.S. 2, the viewing significance of the project area, including the Cabinet Mountains Wilderness, is low or moderate.

The proposed plant site, adits and associated access roads are in the retention objective class, with the proposed tailings impoundment site and access road to the impoundment site in the modification class. Transmission line alternatives cross retention, partial retention, modification and maximum modification classes, as well as privately owned (non-federal) lands which are not included in the Forest Plan visual quality objectives. The Cabinet Mountains Wilderness, the boundary for which is just west of the proposed plant site, is in the preservation class.

The landscape character of the project area is varied due to the topographic and vegetative diversity of the Cabinet Mountains and surrounding areas. Visual absorption capability is a measure of a landscape's ability to absorb visual change. Seven landscape types were identified in the project area as discussed in the following sections.

Cabinet canyons. The plant site and the Libby Creek adit would be located in this landscape type. Cabinet canyons consist of very diverse topographic and vegetative features. Canyon floors are relatively long and narrow and the sides are steep and generally moderately to heavily forested with coniferous trees. Greater plant diversity and denser undergrowth occur near valley floors. This type has a high visual absorption capacity. Views in the mountain canyons are limited due to the vegetation canopy and view angle, which is acute from some areas and screened by landforms.

Cabinet shoulders. Cabinet shoulders consist of the truncated ridges extending eastward from the Cabinet Mountains. Topography consists primarily of steep side slopes without much landform diversity. Vegetation is generally dense coniferous forest. These shoulders are highly visible from a number of viewpoints and they have a low visual absorption capability. No mine-related disturbance on this landscape is proposed.

Intermountain valley floor. The proposed tailings impoundment would be located in the valley floor type. Topography consists of gentle slopes and vegetation is dense coniferous forest. This landscape has moderate-to-high ability to absorb visual change. Timber harvesting in the area has created a diversity of vegetation classes, colors and heights.

Natural viewpoints are located on the KNF roads that criss-cross portions of the valley. Primary access to the mine area occurs on the existing Bear Creek and Libby Creek roads. These roads are collector roads with moderate viewing significance. Most of the travel routes located in the valley offer very limited view duration. Generally, vegetation screening is in the foreground with the Cabinet Mountains in the background. The Libby Creek Recreation Gold Panning Area, with moderate viewing significance, is located in this landscape type. It would be crossed by the proposed transmission line.

Vegetated mountain faces. This type would be crossed by all transmission line routes; it is the most common type in the transmission line corridor area. Topography in this type is generally steeply sloped with a low landform diversity. Typically, the area is heavily forested with coniferous trees, although a fair amount of timber harvesting has occurred. The visual absorption capability of this area is low.

The Teeters Peak Trail, Barren Peak Trail, and portions of the Libby Divide Trail are all located within this landscape type. These recreation trails have moderate viewing significance. Views from high points along these trails are panoramic, offering views to most of the valley floor and Cabinet Mountains. Extended view durations exist on roads such as the Horse Mountain Road, that climb in the same direction for long distances. The Howard Lake campground, with moderate viewing significance, also is located in this landscape type. Alternatives 1 and 4 would be visible where they would cross the ridge into the Miller Creek drainage southeast of the lake.

Open mountain faces. Segments of all transmission line alternatives would cross this landscape type. Found primarily on south and west-facing slopes within the Miller Creek drainage, on Horse Mountain, and along the Fisher River, these areas provide a moderate-to-high visual absorption capability. Topography is generally steep and slopes are dissected with small drainages. Vegetation type and color are diverse, with open grassy areas interspersed with coniferous trees. Timber harvesting has also contributed to the diverse vegetation patterns. The Miller Ridge Trail and portions of the Libby Divide Trail with moderate viewing significance are found in this landscape type. These ridge trails offer more open, panoramic views of long duration.

Valley plain. The Fisher River corridor, with moderate-to-high visual absorption capability, comprises this type. It has gentle to flat terrain and a diversity of vegetation patterns and colors. All transmission line alternatives would cross this corridor four to five miles north of the proposed Sedlak Park substation. Deciduous riparian vegetation, conifers, and irrigated pastures contribute to the diverse vegetation patterns and colors. U.S. 2 with high viewing significance follows this corridor. Views from along the highway are of short duration and are sometimes screened by adjacent vegetation. Scattered rural residences also are present.

Riparian valley. The Schrieber Lake/Swamp Creek valley and Miller Creek valley comprise this landscape type. The flat topography of these valley floors, high vegetation diversity, and limited view distances combine to give high visual absorption capability to these areas. Views from roads that traverse these narrow valleys are typically limited to the foreground by vegetation and surrounding steeper topography. Openings created by timber harvesting or agricultural lands provide more open and longer distance views.

RECREATION

Recreational use in the project area occurs within two districts of the KNF—the Cabinet Ranger District and the Libby Ranger District. There are 418,000 acres within the Cabinet Ranger District and 350,000 acres within the Libby Ranger District. The KNF has management responsibility for recreational uses of these lands. The Montana Department of Fish, Wildlife, and Parks manages wildlife populations and sets limits on fishing and hunting activities. All surface facilities would be located within the Libby Ranger District of the KNF.

Recreational Uses

The most prevalent form of recreation in both districts is travel and viewing, comprising nearly 66 percent of the total recreational use in the Libby District (Table 3-28). Other forms of recreation in the Libby Ranger District are individually less than 10 percent of the total recreational use. Travel and viewing in the Cabinet District is slightly less than

Table 3-28. Recreational use by activity type.

Activity	Entire forest	Cabinet District	Libby District
	—(thousands of visitor days)—		
Camping & picnicking	332.9	21.5	10.0
Travel & viewing	600.2	74.9	116.0
Hiking & horseback riding	104.7	29.5	10.7
Winter sports	20.2	1.7	2.8
Resorts & cabins	20.8	—	.4
Wilderness	7.7	3.0	11.0
Hunting	93.2	20.3	4.5
Fishing	224.6	10.9	7.4
Nature studies	20.6	—	6.8
Other recreation	93.1	—	4.0
Total	1,518.0	161.8	173.6

Source: Noranda Minerals Corp., 1989a. V. 1, pp. I-143-4.

half of the total; hiking and horseback riding, and camping and picnicking are also important recreational uses. Some the major recreational uses are described in the following sections.

Travel and viewing. Travel and viewing is a diverse form of recreation that occurs along the forest roads within the project area. The most heavily used roads are the Libby Creek Road and the Bear Creek Road. Less travelled roads used for travel and viewing connect with the two primary roads.

Camping and picnicking. The Howard Lake campground is the only fee campground within the project area. The campground fee is $5 for each night of camping; fee camping season is from Memorial Day to Labor Day. The campground gets limited use outside the fee period. Over the past five years, camping use has ranged from a low of 640 visitor days in 1987 to a high of 1,750 visitor days in 1988, and averages nearly 1,400 visitor days. The KNF estimates that fee camping comprises just under 30 percent of the total visitor use (Glenn Gibson, Libby Ranger District, pers. comm., January 10, 1990).

Hunting. The Cabinet Ranger District regulates the activities of 21 outfitters, who act as guides for hunting and fishing. The Libby Ranger District has four permitted outfitters. Actual service days for the outfitters in the Libby Ranger District in 1988 were 145. Planned service days in 1989 were 265.

Resident and nonresident elk licenses are sold statewide and are valid statewide. The mine area is located in hunting district #104 for deer, elk and black bear, district 100 for mountain goats, and district 105 for moose. Hunting information is presented in Table 3-29.

Table 3-29. Hunting use in project area

	Harvest	Hunters	Hunter days
Deer	560	1,738	9,702
Elk	105	1,043	6,337
Black bear	42	—	—
Moose	15	15	104
Mountain goat	7	8	40

Source: 1990 Montana statewide harvest survey.

Fishing. Fishing is a relatively minor activity in the Libby Creek drainage. Recreational angling in the drainage typically averages about 800 angler-days, or 2,600 hours of recreational angling per year (J. Vashro, MDFWP, pers. comm. w/ D. Perkinson, KNF). The majority of the fishing occurs in Howard Lake. The total fish catch probably is in the 500 to 1,00 fish range, with Howard Lake providing the majority of fish. Little Cherry Creek provides a very small portion of the recreational fishing opportunity.

Firewood gathering. A firewood permit is required for the collection of firewood on the KNF by individuals. Each permit allows the holder to gather up to two cords of firewood and can be used throughout all National Forests in the region. A total

of 373 firewood permits were issued for the Libby Ranger District in 1989. Firewood collection in the proposed project area occurs primarily near established roads.

Gold panning. The Libby Creek Recreation Gold Panning Area offers the general public the opportunity to pan for gold in a historic area of placer mining. This area was acquired by the KNF in 1987 and opened to public access in 1988. Present use is low, but is expected to increase as the public learns of this recreation opportunity.

Winter activities. Winter activities include ice fishing, cross-country skiing and snowmobiling. Winter activities in the project area are highest near Bear Creek and Poorman Creek, which provide good areas for skiing and snowmobiling. Portions of the Bear Creek Road are plowed all winter, providing skiing and snowmobiling access to Bear Creek and Poorman Creek areas. The Libby Creek Road is plowed to the Crazyman Road by Lincoln County and and beyond by Noranda to provide access to the Libby Creek adit. Some winter activities occur on the Libby Creek road. Howard Lake is used for ice fishing.

Estimates of Recreational Use

Total traffic counts for the Libby Creek Road (USFS Road 231) in 1989 indicate a total of 13,397 vehicles for the period of July 13 through November 20, an average of 103 vehicles per day. Total traffic counts in 1989 for the Bear Creek Road (USFS Road 278) indicate a total of 16,438 vehicles for the period of May 16 through November 20, with an average of 87 vehicles per day. The annual number of recreation visitors on the Libby Creek Road is estimated to be greater than the Bear Creek Road. Some of the measured traffic on both roads is related to the Montanore Project.

Trails. Three trails in the Cabinet Ranger District provide access to portions of the Cabinet Mountains Wilderness potentially affected by the Montanore Project. These trails are St. Paul Lake, Wanless Lake, and Rock Lake.

The Libby Ranger District has two type of trail heads, "managed" and "unmanaged." There are no managed trail heads in the project area. The Libby Ranger District maintains registration boxes at 12 managed trail heads, one of which, Leigh Creek, is located near the mine area. Many of the trail heads in areas where the surface facilities would be located are unmanaged. Trails in the vicinity of the proposed surface facilities are used by a very small percentage of the visitors to the Libby Ranger District (Table 3-30). Summer trail use for managed trailheads accounts for nearly 80 percent of the total use.

Cabinet Mountains Wilderness

The project area is adjacent to and east of the the Cabinet Mountains Wilderness. All project facilities would be outside the wilderness. The Wilderness Act directs the Forest Service to protect the natural character of the wilderness and to provide for recreational, scenic, scientific, educational, cultural,

Table 3-30. Unmanaged trail heads in the project vicinity.

Trail	Visitors	Summer visitor days
Snowshoe Creek	20	25
Big Cherry Creek	10	10
Bear Creek	200	100
Cable Creek	25	25
Poorman Creek	25	50
Ramsey Creek	25	25
Libby Creek	25	50
Gloria	10	25
Wayup	10	25
Great Northern	10	25
Project area total	250	360
District total	5,081	12,045

Sources: Noranda Minerals Corp. 1989a. V. 1, p. I-141; and C. Howard, KNF Resource assistant, pers. comm. w/ R. Trenholme, January 27, 1992).

and historical uses of wilderness areas. Based on the Wilderness Act's definition of wilderness, the Forest Service describes four requisite attributes of wilderness. The Cabinet Mountains Wilderness provides the following attributes—

- natural integrity;
- apparent naturalness;
- outstanding opportunities for solitude; and
- opportunities for primitive recreation.

These attributes are applied to the conditions inside the boundaries of the wilderness. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not require that adverse affects associated with those activities be mitigated. Buffer zones for adverse effects are considered to be inside and not outside the wilderness boundary.

Natural integrity is the extent to which long-term ecological processes are intact and operating. This attribute describes how human influences alter natural processes by comparing an area's condition to its probable state after human contact. Apparent naturalness is closely related to natural integrity. Both qualities may be altered by the same activities. Apparent naturalness focuses on how the activities are perceived by the general public. Impacts are seen, heard or smelled. Solitude is isolation from sights, sounds, and the presence of others. The developments and evidence of man do not appear. Features that contribute to solitude include size of area and distance from perimeter to center. Vegetation and topographic screening are also related to solitude. Primitive recreation provides opportunities for isolation from the evidence of man. Visitors may enjoy a high degree of challenge and risk, and use of outdoor skills.

Cabinet Face East Roadless Area

A large roadless area, the Cabinet Face East Roadless Area, is east of the Cabinet Mountains Wilderness (Figure 3-13). The roadless area provides similar attributes and recreational opportunity as the Cabinet Mountains Wilderness.

TRANSPORTATION

U.S. 2

U.S. 2 is the principal highway in the vicinity of the proposed project. U.S. 2 runs from the western border of Montana eastward through Troy, Libby, and Kalispell. U.S. 2 is a paved, all-weather highway that would be used by all vehicles going in and out of the project area.

The Montana Highway Department recently widened and resurfaced U.S. 2 from south of Libby to the Libby Creek crossing. The improved portion of U.S. 2 extends past the intersection of the two potential access routes to the mine area. The speed limit on U.S. 2 for the first several miles south of Libby is 45 miles per hour (mph); the speed limit then increases to 55 mph.

Traffic information. Table 3-31 shows 1988 average daily traffic (ADT), the 1988 level of service, the

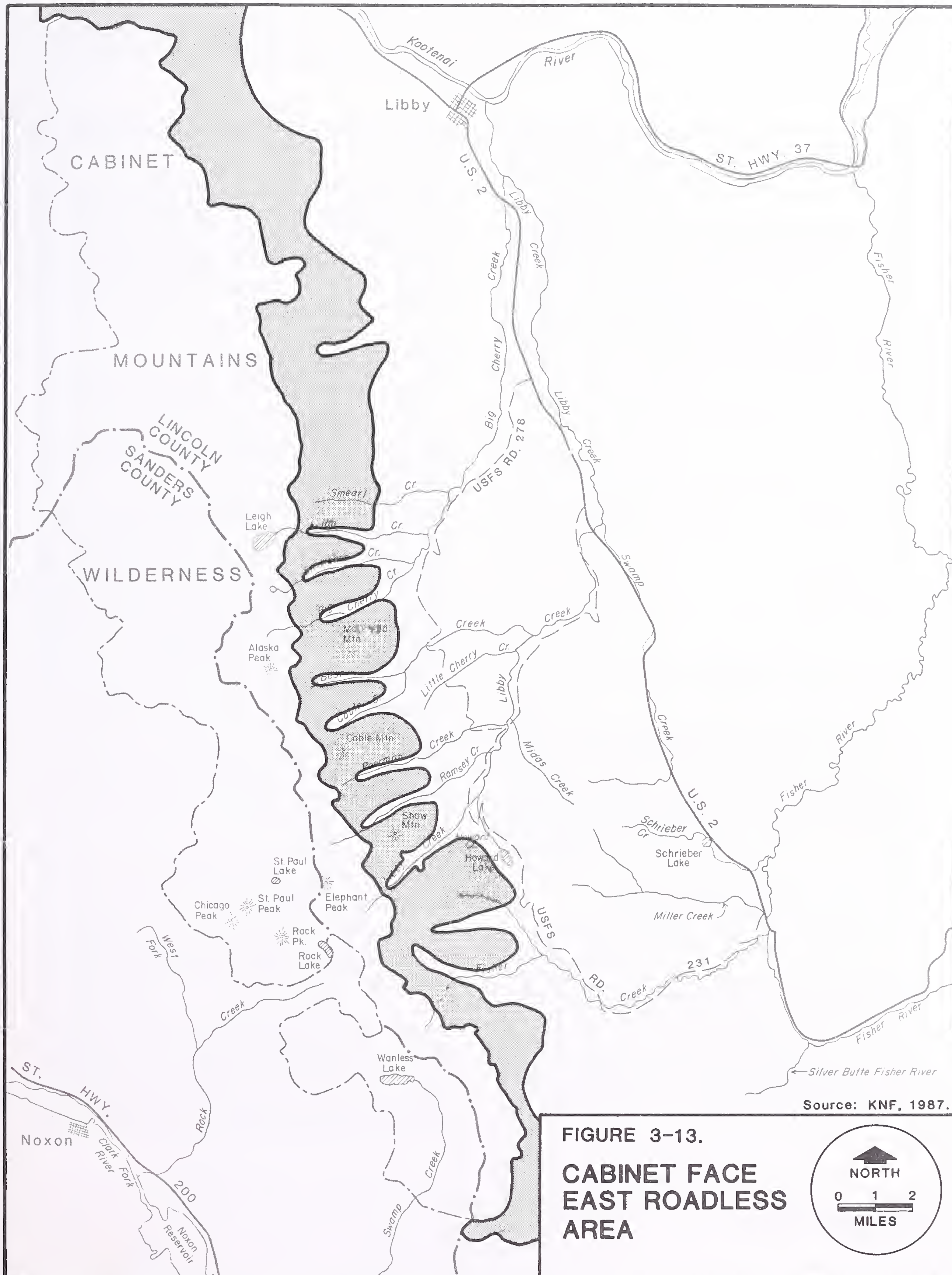
Table 3-31. Existing and projected traffic—U.S. 2.†

U.S. 2 milepost	1988 ADT	1988 Level of service‡	2008 ADT
32.7	7,411	A	10,131
33.3	4,824	A	6,594
37.3	3,149	C	3,880
44.7	1,150	C	1,429

Source: Noranda Minerals Corp., 1989a. V. 1, p. I-112 and I-112a.

†Information is for all lanes.

‡Level of service A provides for the free flow of traffic. The average speed is (at least) the posted speed limit. The speed of vehicles is unaffected by traffic. Level of service C results in the average speed being 5 mph less than the posted speed limit. Oncoming traffic impedes passing.



Source: KNF, 1987.

FIGURE 3-13.

CABINET FACE EAST ROADLESS AREA

ADT projected for the year 2008, and the pavement service index (PSI) for four mileposts on U.S. 2 between Libby and the Libby Creek Road. The current vehicle mix is approximately 40 to 50 percent passenger vehicles, 25 to 30 percent passenger trucks, 8 percent mid-size trucks, 5 to 8 percent single-unit trucks, and 4 percent other vehicle types.

Table 3-32 indicates the distribution of traffic on U.S. 2 by time of day at milepost 35. The peak traffic period is from 3 PM to 5 PM. Traffic volumes on U.S. 2 can vary considerably, depending on area logging activities. Volumes are greatest during the summer tourist season.

Table 3-32. Distribution of daily traffic—U.S. 2.

Time period	Percent
Midnight to 5 AM	2.3
5 AM to Noon	31.2
Noon to 5 PM	37.2
5 PM to Midnight	29.5

Source: Noranda Minerals Corp. 1989a. V. 1, p. I-112a.

Accidents. The total accident rate on U.S. 2 is about 26 percent lower than the Montana average. The severity rate for all accidents on U.S. 2 is about seven percent lower than the Montana average. The truck accident rate on U.S. 2 is about the same as the statewide truck accident rate in Montana. Finally, the truck accident severity rate on U.S. 2 is about 37 percent greater than the Montana average.

Accident statistics further show that accidents along U.S. 2 involve another vehicle about as frequently as the Montana average; accidents involving collisions with animals occur 63 percent more frequently than the Montana average; and accidents involving collisions with fixed objects along U.S. 2 are about the same as the statewide average. Light, power, or signal poles are more likely to be struck along U.S. 2 than on average in Montana. A disproportionate share of accidents on U.S. 2 occurs during rainy conditions.

Bridges. All of the bridges on U.S. 2 between Libby and the Fisher River are concrete bridges. These bridges are designed for legal (80,000-lb.) highway loads. The bridges over Libby Creek and the Fisher River were rebuilt in 1988, replacing old structures.

Roads

Two Forest Service roads currently provide access to (or close to) the proposed mine area from U.S. 2—USFS Roads 278/4781, known as the Bear/Ramsey Creeks Roads, and USFS Road 231, known as the Libby Creek Road.

Bear Creek Road. This road joins U.S. 2 about 7 miles south of Libby and runs southwest approximately 15 miles to the mine area. The first 9.5 miles is an 18-foot, single-lane asphalt road. The design speed is 25 mph. The degree of intervisible turnouts (allowing motorists to see from one turnout to the next) is 50 percent.

The next 4.5 miles of the Bear Creek Road (to the intersection with USFS Road 231, the Libby Creek Road) is an 18-foot gravelled road. The design speed is 25 mph. The degree of intervisible turnouts is 50 percent. From the intersection with the Libby Creek Road, USFS Road 4781 continues southwest for about five miles.

The current traffic volume on the Bear Creek Road is between 50 to 100 vehicles per day. About half of this traffic is estimated to be from logging activities.

Bear Creek Road is not an all-weather road and is closed during spring break-up for vehicles weighing over 10,000 pounds. The peak season of use is from June through September. The road can generally be traveled by all types of vehicles, unless mud or snow requires the use of 4-wheel drive vehicles. Most of the road is not plowed in winter, and when snow is deep, the road is impassable except for snowmobiles. The Bear Creek Road

carries logging and recreational traffic, including snowmobiles.

There is one bridge along the Bear Creek Road, at Bear Creek. It is a wooden structure designed to accept legal highway loads. A culvert is used to cross Poorman Creek.

Libby Creek Road. This road leaves U.S. 2 about 12 miles south of Libby and runs southwest approximately 12 miles to the mine area. Current traffic volume is a little greater than on the Bear Creek Road, ranging between 20 and 120 vehicles per day.

The first 9.2 miles is a 14-foot, single-lane, gravel-surface road. The design speed is 25 mph. The degree of intervisible turnouts is 75 percent. The next 2.4 miles of the Libby Creek Road (from the intersection with the Bear Creek Road to the bridge to Howard Lake) is a 12-foot single-lane aggregate surface road. The design speed is 20 mph. The degree of intervisible turnouts is 50 percent. The third section (USFS Road 2316) runs from the Howard Lake bridge to the end of the road on Libby Creek. It is a 12-foot single-lane native surface road. The design speed is 15 mph. There are no intervisible turnouts.

The Libby Creek Road is not an all-weather road. It is closed during spring break-up for vehicles weighing over 10,000 pounds. The peak season of use is from June through August. The road can generally be traveled by all types of vehicles unless mud or snow requires the use of 4-wheel drive vehicles. The majority of the road is not plowed, and when snow becomes deep, the road becomes impassible except to snowmobiles. It then remains closed until the spring melt. The Libby Creek Road carries logging and recreational traffic, including snowmobiles.

There are two single-lane bridges along the Libby Creek Road over Libby Creek which are designed for legal highway loads. The first bridge is concrete, and was constructed in 1981. The second bridge, near the Old Town site, is a concrete structure, capable of supporting legal highway loads (80,000 lbs.), constructed in 1984 after a flood destroyed the old bridge.

There are several roads capable of providing access for construction of the proposed transmission line or alternative routes—U.S. 2 along the Fisher River and Swamp Creek; a haul road owned by Champion International Corporation. east of the Fisher River; USFS Road 4778; the Midas Creek Road; USFS Road 231 (the continuation of the Libby Creek road past Howard Lake); and USFS Roads 385/4724 in the Miller Creek drainage.

Rail, Bus, and Air Service

The town of Libby is on the east-west route of the Burlington Northern Railroad. Daily freight service is provided, with major destinations being Seattle and Chicago. Amtrak passenger service is also provided at Libby. There is no interstate bus service to Libby. Libby has one local car rental agency. United Parcel Service and Federal Express provide service to Libby.

The nearest airports providing scheduled air transportation are Kalispell and Spokane, Washington. Kalispell is approximately 90 miles and 1.5 hours driving time. Spokane is about 160 miles and three hours driving time. The Libby Municipal Airport is open 24 hours per day, under visual flight rules. Mountain West Flying Service, a local business, offers charter air service from the Libby Airport.

SOCIOECONOMICS

Study Area

Various factors may influence the location and magnitude of potential socioeconomic impacts. These include—

- the location of and access to the ore body and to the proposed permit area;

- the likely residence area for people working at the mine (existing residents and/or any in-migrating project employees);
- the rate and magnitude of in-migration (which will be influenced by the availability of a trained or trainable local workforce and a developer sponsored training program);
- the rate and magnitude of population and employee turnover (including student population turnover in schools, employee turnover at the mine, and employee turnover from existing jobs to employment with the Montanore Project);
- the availability and location of housing and existing and potential housing sites;
- in relation to potential housing locations, the capacity and condition of existing local services and facilities;
- the people directly/indirectly affected economically by the proposed mining operation (e.g., from wages and taxes); and
- the willingness and ability of community residents and local government personnel to deal with change.

Based on these factors, the primary socioeconomic impact area for the proposed project is the southwestern portion of Lincoln County along U.S. 2 including the Troy and Libby areas. Affected jurisdictions in the study area include Libby and Troy (both incorporated cities), Lincoln County, and the Libby and Troy School Districts.

Relevant baseline information is also presented on the existing socioeconomic environment for Sanders County. The ore body is located in Sanders County, and cumulative impacts may have some effect in Sanders County. As discussed in Chapter 4, no persons are expected to move to Sanders County as a direct result of the proposed project.

Employment and the Economy

The Lincoln County economy is natural-resource based, with the lumber industry playing an important role. Manufacturing (including timber harvesting and wood products manufacturing) is nearly 18 percent of all Lincoln County businesses (Table 3-33). The major wood products employer is Champion International Corporation, located in Libby. In recent years, Champion has been the largest employer in the county, employing approximately 700 people at full production and, depending on the time of year, also contracting with several hundred independent loggers. However, Champion laid off about 150 employees in the summer of 1990, and announced a temporary

Table 3-33. Private business establishments by employment size—Lincoln County.

Category	Total number of establishments	Number of employees				
		1-4	5-9	10-19	20-50	Over 50
Mining	3	1	0	0	0	2
Construction	27	22	4	1	0	0
Manufacturing	87	45	21	13	6	2
Transportation	22	14	4	2	2	0
Wholesale trade	12	6	5	1	0	0
Retail trade	138	84	32	15	6	1
Services	123	91	17	9	5	1
Finance, insurance and real estate	16	13	0	1	2	0
Other	64	60	2	2	0	0
All establishments	492	336	85	44	21	6

Source: Economic Consultants Northwest. 1989. p. 4.

shutdown of its Libby operations in early 1991 due to changing market conditions. The facility re-opened in April 1991 with about 420 employees.

The characteristics of the wood products industry create a complicated and highly cyclical economy. Unemployment rates for this industry have traditionally varied from year-to-year and season-to-season, ranging from almost 20 percent during the winter, to around 10 percent during the summer.

In 1988, three mining employers in Lincoln County accounted for about 7 percent of all county employment. In 1979, ASARCO, Inc. developed the Troy Mine, a silver and copper mine south of Troy, which is still operating and employs about 350 workers. W.R. Grace & Company operated a vermiculite mine near Libby employing about 85 people during full operations until late 1990, when the facility was closed.

Other major private employers in Lincoln County are in the services and transportation, communication and public utilities sectors. The key employer in the services sector is St. John's Lutheran Hospital in Libby. Major employers in the transportation, communication and public utilities sector include Pacific Power and Light and General Telephone Company.

The largest government employers in Lincoln County are the U.S. Forest Service, the U.S. Army Corps of Engineers, the Bonneville Power Administration, Lincoln County, the Libby and Troy School Districts, and the municipalities of Libby and Troy. Total Forest Service employment in the county is about 300 full-time employees, plus a significant number of seasonal employees. Lincoln County's employment data are presented in Table 3-34.

Table 3-34. Employment by industry—Lincoln County.

Industry	1970	1980	1985	1986	1987	1988	1989
Total Employment	7,042	6,948	7,357	7,590	7,512	7,638	7,977
Farm	133	251	295	294	285	282	286
Nonfarm	6,909	6,697	7,062	7,296	7,227	7,356	7,691
Private	5,732	5,101	5,597	5,884	5,808	5,963	6,284
Agricultural Services	92	167	238	270	213	230	299
Mining	(D)	(D)	(D)	(D)	488	470	467
Construction	1,610	419	311	323	271	439	322
Manufacturing	1,731	1,421	1,497	1,545	1,669	1,574	1,727
Transportation, Communication, and Public Utilities	347	447	338	372	378	404	405
Wholesale Trade	73	82	96	91	72	65	80
Retail Trade	853	999	1,015	1,047	1,121	1,163	1,225
Services	(D)	(D)	(D)	(D)	1,319	1,352	1,457
Finance, Insurance, and Real Estate	118	256	296	320	277	266	302
Government	1,177	1,596	1,465	1,412	1,419	1,393	1,407
Federal (civilian)	457	759	570	507	525	515	512
Federal (military)	142	107	99	107	111	112	116
State and Local	578	730	796	798	783	766	779

Sources: Economic Consultants Northwest. 1989. p. 13. and U.S. Dept. of Commerce, pers. comm. w/ M. Stanwood, 1990 and 1991.
(D) = Data not shown to avoid disclosure.

The civilian labor force in Lincoln County has grown from 7,275 in 1970 to 8,619 in 1991, an 18.5 percent increase in 21 years. This growth rate is slower than the increase in the statewide labor force over the same period. The Lincoln County labor force has remained in a narrow range in recent years, with a low of 8,431 and a high of 8,879 from 1983 to 1991.

The average unemployment rate in Lincoln County varied from 8.9 percent in 1970 to 15.5 percent in 1980. From 1985 to 1990, the unemployment rate in Lincoln County ranged from 10.2 to 11.6 percent. This rate was higher than the state rate, which averaged 7 percent over the last 20 years. In 1991, the Lincoln County unemployment rate jumped to 16.3 percent, the highest rate since 1982 when the County had a 19.4 percent unemployment rate. Historically, the Lincoln County unemployment rate has varied between 10 and 18 percent within any year due to the seasonality of the wood products industry.

Table 3-35 presents job applicants by mine-related occupational groups registered at the Libby Job Service Office over an 11-month period in 1987 and 1988. These groups represent applicants who could potentially be trained to work in construction and operation jobs of underground mines, such as the proposed project. The total number of applicants varied between 900 and 1,300 over the period. According to Gay Myrhang, Manager of the Libby Job Service Center, there is a similar pool of available skilled and unskilled workers in early 1992 (Gay Myrhang, personal communication w/ M. Stanwood, January 27, 1992).

In 1990, the average annual wage for all workers in Lincoln County was $19,205 (Table 3-36), about 7 percent higher than the average wage of all Montana workers. The mining industry in Lincoln County pays over 50 percent above the average and is the highest paying group in the county. Total 1990 wages reported in Lincoln County by the U.S. Department of Commerce was about $106 million. Retirement and governmental transfer income have been playing an increasingly important role in the Lincoln County economy in recent years.

Recent data indicate there is no dominant industry in Sanders County. In the manufacturing sector, Washington-Idaho Forest Products is the largest single employer with up to 140 employees, plus 100 to 150 independent loggers during full production. There are only two mining operations in Sanders County. The largest is U.S. Antimony Company, which operates a small mine and concentrator facility employing 35 people during full operation.

Table 3-35. Job applicants—Libby Job Service Office.

Occupation	1987			1988							
category	Oct.	Nov.	Dec.	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.
Equipment operators	136	108	96	116	153	166	157	NA	141	148	118
Truck drivers	98	37	91	99	123	134	133	NA	120	91	100
Technicians (mine-related)	134	96	102	78	158	186	156	NA	141	145	115
Mechanics	58	18	40	13	68	71	64	NA	57	61	47
Laborers	635	540	484	573	715	731	736	NA	792	733	609
Other	197	178	169	53	220	245	242	NA	215	227	167

Source: Economic Consultants Northwest. 1989. p. 11.

The major employer in the services sector in Sanders County is Clark Fork Valley Hospital in Plains. Other employers in the services and retail trade sectors are dispersed throughout the many small towns and communities in Sanders County. The U.S. Forest Service, Sanders County, school districts, and local governments are the primary government employers.

The civilian labor force in Sanders County increased 48 percent from 1970 to 1980, but declined by nearly 18 percent between 1980 and 1985. Since 1985, the labor force has decreased slightly, with 3,079 people reported in the civilian labor force in 1990. The unemployment rate in Sanders County has averaged about 14 percent since 1980, twice the average unemployment rate for Montana. In 1990, an estimated 12.4 percent of the total civilian labor force was unemployed in Sanders County.

The average annual wage in Sanders County was $15,125 in 1990, about 15 percent lower than the Montana average. The highest paying jobs in Sanders County are with the federal government and in the transportation, communication, and utility economic sector. Total wages paid in 1990 in Sanders County is estimated by the U.S. Department of Commerce at over $32 million.

Population and Demographics

The population of Lincoln County more than doubled from 1940 to 1970 (Table 3-37). The largest increase for Lincoln County was between 1960 and 1970 during the Libby Dam construction. The population decline between 1970 and 1980 was due to the dam completion. The population of Libby and Troy increased between 1940 and 1980, with growth rates about the same as the state-wide rate.

The population of Lincoln County increased steadily between 1980 and 1987. However, the estimated 1990 populations of Libby, Troy, and Lincoln County as reported by the U.S. Census Bureau have declined since the 1980 census. One important demographic trend evidenced by comparing the 1980 and 1990 census data is the increasing portion of elderly persons residing in the area, even though the

Table 3-36. Average annual wages—Montana and Lincoln County, 1990.

Industry group	Montana annual average wage	Lincoln County: Average annual wage	Lincoln County: Percent of state average	Lincoln County: Percent of county average
All industries	$17,884	$19,205	107.4	100.0
Mining	33,309	30,213	90.7	157.3
Federal government	26,986	23,764	88.1	123.7
Manufacturing	23,430	25,610	109.3	133.4
Transportation	24,608	21,440	87.1	111.6
State government	21,168	19,017	89.8	99.0
Local government	17,888	18,628	104.1	97.0
Wholesale trade	21,940	19,814	90.3	103.2
Construction	22,328	23,275	104.2	121.2
Finance, insurance and real estate	20,160	14,468	71.8	75.3
Agricultural services	13,157	14,758	112.2	76.8
Services	15,397	10,198	66.2	53.1
Retail trade	10,635	9,197	86.5	47.9

Source: U.S. Department of Commerce, U.S. Census Bureau, 1990.

overall population declined. Therefore, it can be assumed that persons moving away from the area consist primarily of working aged persons and their dependents.

The population of Sanders County increased 25 percent between 1940 and 1980, a growth rate about 50 percent of the state rate. Sanders County population made modest gains from 1980 through 1984. Since that time, Sanders County has lost population at about the same rate as the state as a whole. Estimated 1990 Sanders County population of 8,669 persons as reported by the U.S. Census Bureau is essentially the same as the 1980 population.

Community Services and Facilities

Schools. There are four elementary schools, one middle school, and two high schools in the Libby/Troy area. Libby School District #4 includes Asa Wood, McGrade, and Plummer elementary schools, Libby Middle School, and Libby Senior High School. Troy School District #1 includes Morrison School and Troy High School. In the 1991-92 school year, Libby School District schools were staffed approximately as follows—

- elementary schools—44 classroom teachers and 7 special education teachers;
- middle school—28 classroom teachers and 3 special education teachers; and
- high school—40 classroom teachers and 4 special education teachers.

In the 1991-92 school year, Troy's school staff included 17 classroom and 5 special education/chapter teachers at the elementary level, and 22 classroom and 3 special education/chapter teachers at the high school level.

School enrollment in the Libby School District decreased 17 percent from 2,560 in 1980-81 to 2,126 in 1988-89. In 1991-92 enrollment rose slightly to 2,144. There is presently a ratio of about 19 students per teacher in the district.

Table 3-37. Comparison of selected demographic characteristics—Montana, Lincoln County, Libby and Troy.

Characteristic	Montana	Lincoln County	Libby	Troy
Population				
1940	559,456	7,882	1,837	796
1950	591,024	8,693	2,401	770
1960	674,767	12,537	2,828	855
1970	694,409	18,063	3,286	1,046
1980	786,690	17,752	2,748	1,088
1990	799,065	17,481	2,532	953
Median Age	33.8	34.7	37.1	31.8
Households (1990)	306,163	6,668	1047	358
Persons Per Household	2.70	2.60	2.34	2.66
Race (1990)				
White	92.7%	97.8%	97.7%	97.2%
Native American	6.0%	1.6%	1.6%	1.9%
Other	1.3%	0.6%	0.7%	0.9%

Source: U.S. Department of Commerce, U.S. Census Bureau, 1990.

Troy School District school enrollment fluctuated between 1980 and 1991, from a low of 571 in 1982-83, to a high of 719 in 1985-86. In the 1991-92 school year, 675 students were enrolled resulting in an overall ratio of about 17 students per classroom teacher in the Troy district. Table 3-38 shows estimated physical capacity compared to 1991-92 school enrollment in both districts.

Law enforcement. The Montana Highway Patrol, the Lincoln County Sheriff's Department, and the Troy Police Department provide law enforcement services in the Libby/Troy area. The County Sheriff's Department has a contract with Libby to provide law enforcement services within the city limits of Libby. Four Montana Highway Patrol officers serve the Lincoln County study area—one sergeant and three patrol officers in Libby. Of the 14 deputies in the Sheriff's Department, one resides and patrols in Troy, and 11 are in the Libby area. Six are specifically assigned to the Libby city limits. The Sheriff's Department maintains approximately 15 patrol cars. Many vehicles are getting old and need to be replaced. The Troy Police Department has three full-time officers and owns two patrol cars. There are two jails in the study area—a 24-cell adult jail in Libby and a 2-cell juvenile holding facility in Troy.

Table 3-38. Current enrollment and estimated physical capacity—Lincoln County schools.

School	1991-92 Enrollment	Estimated capacity
Libby School District #4		
Asa Wood Elementary	484	500
McGrade Elementary	264	324
Plummer Elementary	281	324
Libby Middle School	498	650
Libby Senior High	617	700
Troy School District #1		
W.F. Morrison (K-8)	450	525
Troy High School (9-12)	225	230

Source: Economic Consultants Northwest. 1989. pp. 87 and 92; and Letter #8, comments on DEIS.

Fire protection. Fire protection is provided by two rural fire districts (Libby and Troy), the Libby Fire Department, and the Troy Fire Department, all volunteer. The Montana Department of State Lands and the U.S. Forest Service are responsible for fire protection in lands under their jurisdiction. The rural/city Libby Fire Department has 28 volunteers, two firehalls, and nine fire trucks. The Troy rural/city Fire Department has 24 volunteers, one firehall, and seven firefighting vehicles.

Ambulance services. Ambulance services are provided by the Libby Volunteer Ambulance Service and the Troy Volunteer Ambulance Service. The Libby Ambulance Service has a volunteer staff of 33, with approximately 85 percent trained as emergency medical technicians (EMTs). Equipment includes 3 full-time units, a back-up unit, an extraction unit, and a jeep used by a 5-man quick response unit. The Troy Ambulance Service operates with 31 volunteers with twenty certified EMTs and three trained in emergency mine rescue.

Hospital and physician services. St. John's Community Hospital in Libby is the only public hospital in Lincoln County. In fiscal year 1991, the 29-bed hospital operated at 56.8 percent capacity. Demand is highly seasonal, with winter months the highest demand time. The hospital also serves as a temporary source of beds for persons needing nursing home care. The hospital offers 24-hour emergency care services. The hospital is associated with 12 licensed physicians plus several visiting specialists. The Troy area is served by one licensed physician who does not currently have hospital privileges.

Water supply. More than 50 percent of the households in Lincoln County use private wells for water supply. In Libby, approximately 2,000 households and commercial businesses are served by the municipal water system, which obtains water from Flower Creek. Raw water storage capacity is 89 million gallons. The town of Troy receives its

municipal water supply from two wells. The Troy municipal system provides water to an estimated 500 residences and 50 commercial establishments.

Sewage treatment facilities. Approximately 75 percent of the households in Lincoln County, including the town of Troy, use septic tanks for wastewater disposal. The city of Libby has operated a public wastewater treatment facility since 1964, and in 1985, converted from a primary to a secondary treatment facility (i.e., an activated sludge oxidation ditch system). Processing capacity is about 1.1 million gallons per day; the wastewater facility operates at approximately 50 percent of design capacity.

Solid waste disposal. Lincoln County operates a solid waste district for collection and disposal of solid, non-hazardous waste. The major landfill in the study area is located in Libby. Expansion of the landfill may be needed in the next few years. The county places waste containers in rural areas for waste collection. Private trash collectors also serve the county.

Human services. The Human Services office is located in Libby with a staff of 10, five of which are technicians. Funding for the social welfare program comes from state, federal, and county sources with the state administering the program. State budget cuts have recently forced the layoff of one technician. Support includes aid to families with dependent children, food stamps, medical services, and general assistance.

Libraries. There are three public libraries in Lincoln County. The main library is located in Libby, with branch libraries in Troy and Eureka. Interest in library services has been increasing in recent years.

Adequacy of existing facilities and services. Table 3-39 shows a summary of comments by officials within county and city agencies regarding the adequacy services. There are no county-accepted community services and facility standards upon which to gauge adequacy.

Housing

The 1990 census data are the most recent, detailed data on housing. There are an estimated 8,002 housing units in Lincoln County with 6,668 occupied—73.3 percent by owners and 26.7 by renters (Table 3-40). Two-thirds of the year-round housing units are classified as one-unit structures. About 25 percent of the housing units in Lincoln County are mobile homes, twice the state level. Libby has an estimated 1,141 housing units, with 1,047 occupied—56.6 percent by owners, and 43.4 by renters.

City zoning regulations prohibit mobile homes within Libby city limits; Lincoln County has no restrictions on mobile home placement other than those required by the state. A Lincoln County Department of Environmental Health survey (June, 1988) indicates 667 mobile home spaces near Libby with an occupancy rate of 69 percent, and 75 spaces near Troy with an occupancy rate of 61 percent.

Rental housing is not plentiful in Libby or Troy. One reason for the tight rental market is that many residents cannot afford or will not make the long term commitment required for the purchase of a home.

There are approximately 125 rental apartments in the Libby area. Vacancies fill quickly. Rental housing in Troy is also scarce. An estimated 16 percent of 263 motel rooms in Libby and Troy are equipped with cooking facilities. Most of the motels have weekly or monthly rates, particularly during the relatively slow winter period.

Fiscal Conditions

The proposed project could affect the public budgets of Lincoln and Sanders counties, the cities of Libby and Troy, and those cities' school districts. Basic descriptions of key budget areas for each of these jurisdictions are presented in the following sections.

Table 3-39. Summaries of comments on the adequacy of community and facilities and services.

Agency/Service	Contact	Date	Comment
Libby schools	Bill Donahue and Connie Donahue	1/21/92	Needs additional staff. Elementary school facilities close to capacity.
Troy Schools	Shelly Hawthorne	1/21/92	Additional room needed in high school.
Lincoln Co. Sheriff Dept.	Orville Thorn	1/23/92	Additional officers needed; vehicles getting old.
Troy Police Dept.	Charlie Muchmore	1/23/92	Adequate staff and vehicles.
Libby Fire Dept.	Bill Kemp	1/23/92	Adequate volunteers; two aging trucks need to be replaced.
Troy Fire Dept.	Roger Kensler	1/27/92	Adequate volunteers and equipment.
Libby Ambulance Service	Bob Stickney	1/24/92	Adequate vehicles and volunteers; need additional funding for operating expenses.
Troy Ambulance Service	Warren Robbe	1/23/92	Adequate volunteers and equipment.
St.John's Hospital	Ron Wiens	1/23/92	Adequate beds and staff. Community needs additional nursing home facilities.
Libby Water Supply	Bill Kemp	1/23/92	Need to change groundwater source or add water treatment system by 1993; studying options.
Troy Water Supply	Roger Kensler	1/27/92	Adequate system; O'Brien Creek now used only in emergencies.
Libby Wastewater Treatment Facility	Al Eldridge	1/27/92	System at 50% of capacity.
Libby Landfill	Dan Bundrock	1/27/92	Possible expansion onto USFS land in several years.
Lincoln County Social Services	Susan Smith	1/23/92	Needs additional staff and funding.
Lincoln County Libraries	Kathy Powers	1/23/92	Library would like to expand services to meet increasing demand.

Source: Personal communications w/ M Stanwood, IMS in early 1992.

Table 3-40. 1990 housing data—Lincoln County and Libby.

Characteristic	Lincoln County	Libby
Total housing units	8,002	1,141
Occupied units	6,668	1,047
Owner occupied	4,888	593
Percent owner occupied	73.3%	56.6%
Renter occupied	1,780	454
Vacant units	1,334	94
For occasional or seasonal use	581	1
Homeowner vacancy rate	1.7%	2.3%
Rental vacancy rate	10.0%	5.6%
Median value of owner-occupied units	$41,800	$41,100
Median rent of renter-occupied units	$197/mo.	$204/mo.

Source: U.S. Census Bureau, 1990

Lincoln County. Total taxable property valuation (the value ascribed to personal property for tax purposes) peaked in Lincoln County in fiscal year (FY) 1986 at $36.5 million. Since that time, valuation has dropped 16.5 percent to approximately $30.5 million. A large portion of the decrease is due to the closure of the W.R. Grace vermiculite mine. The major tax base component in Lincoln County is Land and Improvements, which amounted to about 85 percent of the total tax base in FY 1992. The major revenue source to Lincoln County government is intergovernmental transfers (over 60 percent in FY 1991). Between 1980 and 1988, revenues from property taxes increased 78 percent from $759,188 to $1,350,312. General fund revenues also increased by approximately the same amount during this 8-year period. Based on 1992 taxable valuation and County mill levies, 1992 property tax revenues should be approximately $1.05 million.

Expenditures for Lincoln County reached $323 per capita in FY 1986, but dropped during the late 1980s. Per capita expenditures in FY 1991 were $375. In FY 1991, 22 percent of the budget was spent on general government, 23 percent on public safety, and 36 percent on public works.

Libby. Taxable valuation for Libby has declined from $3.81 million in FY 1980 to $3.08 million in FY 1992, a 19 percent decline in the tax base. Non-tax revenues for Libby have played an increasingly important role since 1980, which somewhat masks the significant decline in property tax revenues from $294,562 in FY 1980 to $202,021 in FY 1992.

Total expenditures for Libby have been fairly consistent since FY 1980. Public works expenditures decreased from 21 percent of the FY 1980 budget to about 17 percent of the current budget.

Troy. Troy's taxable valuation increased slightly between FY 1980 and FY 1987 from $700,800 to $731,400. By FY 1992, the taxable valuation had declined to $679,098. The most important revenue sources are property taxes and transfers. Expenditures for general government in Troy usually require about 33 percent of the budget; expenditures for public safety require approximately 40 percent of the budget.

Libby School District. Similar to the Lincoln County tax base, the taxable valuation for Libby School District #4 (elementary and high school) declined by approximately 5 percent between FY 1986 and FY 1988. Further declines have occurred since that time, with the taxable valuation reaching about $16 million in FY 1992. Total revenues to the Elementary School District increased about 40 percent between FY 1981 and FY 1988. Most of this increase was from the state equalization program. Revenues budgeted in FY 1992 show an increase of about 15 percent over 1988 levels. The per Average Number Belonging (ANB) expenditures at the Libby Elementary School District rose from $3,048 per student in FY 1981 to $3,697 in FY 1987. In FY 1988, per ANB expenditures declined slightly to $3,593. In FY 1992, per ANB expenditures should be about $3,950.

Total revenues at Libby High School District #4 have followed the same pattern as in the Elementary School District. About 80 percent (or $2.7 million) of total revenues in the FY 1992 budget are general fund revenues. Per ANB expenditures at the high school level show an increase in recent years, rising to about $5,600 for the FY 1992 budget.

Troy School District. The taxable valuation for Troy School District #1 (elementary and high school) increased by almost 200 percent between FY 1981 and FY 1986. This increase is entirely attributable to the ASARCO Troy mine. Total revenues for Troy Elementary School District doubled between FY 1981 and FY 1988; expenditures increased by over 100 percent between FY 1981 and FY 1986, while per ANB expenditures increased by over one-third during this same time period. Revenues at Troy High School District #1 increased by approximately 80 percent from FY 1981 to FY 1986.

Sanders County. Total taxable valuation in Sanders County increased from $19.5 million in FY 1980 to $30.9 million by FY 1986. In FY 1991, the taxable valuation had dropped to $24.1 million, a decrease of 22 percent since 1986. Total revenues for Sanders County more than doubled between FY 1980 and FY 1987. Revenues in FY 1991 were slightly higher than those in 1987. Revenue increases have been attributable both to increased property taxes and federal and state intergovernmental transfers. Per capita expenditures declined between FY 1980 and FY 1986 but have increased since then to about $450 per person in FY 1991. General government expenditures usually total about 20 percent of the budget, while expenditures for public works have comprised 37 to 53 percent of the budget over the past ten years.

Social Structures and Quality of Life

Social structure and interaction in the Libby and Troy areas has been shaped primarily by geographic isolation, migration and settlement, a resource extractive economy, extra-local influence on the economy, and a cyclical economy. Railroad construction brought small, transient populations of Chinese and Greeks, but the ethnic background of most settlers was northern European. The German and Scandinavian heritage originally associated with the lumber industry is still evident in Libby. Individual reliance on one's immediate family and social groups for support has fostered cohesiveness in the Libby and Troy communities that has provided resiliency during difficult economic periods. People in the area attend church regularly and often organize groups to assist others in need. While Lincoln County residents have a slightly lower educational attainment level than Montana residents as a whole, study area residents desire a strong education for their children.

Since mining and logging are cyclic industries—influenced by national or international economics—the area is economically insecure. Industrial development capital comes primarily from external sources, and local employees may perceive that they have little influence over their destiny. Similarly, the U.S. Forest Service manages about 75 percent of the land in Lincoln County. Many Libby area residents adapt to the economy's cyclic nature by enhancing their personal resources by such activities as hunting, fishing, gardening, firewood gathering, berry picking, and other "do-it-yourself" skills. Local residents acquire vehicles, homes, and other possessions which are functional, rather than ostentatious. Many Lincoln County residents, because of their livelihoods, are closely linked to the natural environment and have a conservation ethic, but may not necessarily favor preservation that would prohibit development of natural resources.

A quality of life survey indicates Lincoln County residents highly value the natural environment and the rural, small town atmosphere of the area (Economic Consultants Northwest, 1989). Air pollution, particularly in fall and winter, was frequently mentioned as unaesthetic and a public health problem. There is a strong community identity in both Libby and Troy residents. Most

residents believe they are self-reliant, but also feel the community is responsive to the unfortunate.

Area social problems reported by survey respondents include alcoholism, drugs, family abuse, teenage pregnancy, divorce, crime, and lack of motivation. Alcoholism and drugs were mentioned most often. Community services are generally viewed as average or above average. Residents typically try to buy goods in Libby, but cite limited selection as a limitation. Shopping for clothing and other small articles is often done in Kalispell or Spokane, while major purchases (such as automobiles) are often made in Libby. The economy of Lincoln County was viewed as depressed to stable, and not able to support adequate employment.

The population of Sanders County is relatively sparse and dependent on the area's natural resources for employment, recreation, and in some cases, subsistence. The limited possibilities for employment and lifestyle diversity limit contact between the local population and different people from outside the area. The relative isolation of Sanders County residents tends to have a homogenizing effect, resulting in sharing of common life experiences and developing similar perspectives toward life.

A quality of life survey indicated residents were nearly universal in their satisfaction with the county as a place to live (Economic Consultants Northwest, 1989). Like Lincoln County residents, Sanders County residents value the area's natural and rural qualities. Typically, Sanders County residents purchase major items such as automobiles from Missoula, Sandpoint, or Spokane. Local stores are thought to be high-priced and lacking in a wide selection. Community services are generally viewed as average.

Social problems reported include racism, child abuse, divorce, drugs, alcoholism, and crime, and were not consistently identified by respondents. The economy of the area is described as depressed to stable. Important perceived local needs are additional jobs and increased wages.

Future Baseline Environment

In order to compare the effects of the proposed action on the socioeconomic environment, major socioeconomic conditions and characteristics must be projected into the future. Baseline population projections in five-year increments through the year 2010 were prepared to represent the future baseline socioeconomic environment (Economic Consultants Northwest, 1989). The projections included in the DEIS were generated through use of a National Planning Association model using data on employment and income from the U.S. Bureau of Economic Analysis. These projections do not include the effects of the proposed project. For the FEIS, these projections have been revised slightly downward to reflect 1990 U.S. Census population data.

Total Lincoln County employment is projected to increase 7.3 percent between 1990 and 2005. This annual growth rate of 0.5 percent is consistent with historical 1970-85 trends. Most employment growth beyond 1990 is projected to occur in the private sector, with the largest gains in the services sector. Manufacturing is projected to decrease over the period 1990-2010.

The population of Lincoln County is projected to increase very gradually over the period 1990-2010 (Table 3-41). Average annual population increases are about 0.5 percent, or approximately 40 persons per year, over this period.

Employment in Sanders County is projected to increase very marginally over the 1990-2010 period. Employment increases in services, finance, and retail are offset by employment decreases in farm and manufacturing employment. Sanders County population is projected to incur an average annual growth rate of about 0.6 percent over the 1990-2010 period. These projections do not include any effects of the proposed ASARCO Rock Creek project. Chapter 4, *Socioeconomics*, provides a discussion of the cumulative employment and population

Table 3-41. Population baseline projections in Lincoln and Sanders counties.

	1990 Census	1996	2000	2005	2010
Lincoln County					
County	17,481	17,574	17,769	18,021	18,282
Libby	2,532	2,558	2,597	2,640	2,691
Troy	953	963	978	994	1,013
Sanders County	8,669	9,080	9,377	9,626	9,922

Source: Economic Consultants Northwest. 1989. p. 16 and p. 48, and IMS, Inc.

interactions between the proposed Montanore Project, the proposed Rock Creek Project, and the closure of the ASARCO Troy mine.

CULTURAL RESOURCES

At the time of Euro-American contact, two major ethnic groups occupied and used areas which include the current project area. The Kalispell or Lower Pend d'Oreille occupied the Clark Fork River drainage from the area around Lake Pend d'Oreille in Idaho to the vicinity of Plains, Montana. The Kootenai occupied the area drained by the Kootenai River in Montana and the Kootenay and upper Columbia rivers in British Columbia. They occupied semi-permanent winter encampments and seasonally exploited other sites. The Kootenai, who subsisted on a hunting-gathering economy based primarily on fish, big game and camas, have used the project area for the last three to five centuries.

The first contact between Native Americans and Euro-Americans in the area was initiated by explorers and fur traders. The first whites to enter the project area were probably employees of the Northwest Company sent into the region in 1801. Several trading posts were established in the region and travel routes such as the "Kootenai Road" became important links to connect the Kootenai River region with the trading posts.

More permanent Euro-American settlements resulted from the influx of people during the gold strikes of the 1860s and the construction of the transcontinental railroads through the Clark Fork Valley in 1883 and the Kootenai Valley in 1892. There was placer mining along Libby Creek by 1867-1868. Settlement along the Kootenai River was limited to the town of Tobacco Plains until the late 1880s, when Old Town was established near Howard Creek's confluence with Libby Creek. Old Town was abandoned in 1889 with the establishment of Old Libby, which in turn was abandoned in 1891 when the route for the Great Northern Railroad was established closer to the Kootenai. Placer mining in the Libby Creek drainage peaked in the early 1900s. Both railroads and mining contributed to the development of the timber industry, which became the economic base in both Lincoln and Sanders counties.

A major change in the region resulted from the establishment of the Forest Reserves, later known as National Forests. Lands within the reserves came under the administration and protection of the federal government, and timber cutting became regulated. Portions of the land within the project area were included in the Cabinet Forest Reserve, now part of the Libby and Cabinet Districts of the KNF.

Native American Resources

Native American history of the project area has been described in the previous section. In accordance with the American Indian Religious Freedom Act, Native American concerns and values for cultural resources of contemporary or historical significance within the project area were addressed. The major

goals of the Native American contacts were to develop an inventory of significant past or present cultural resources and the activities associated with them, and to document concerns and recommendations for preservation and/or mitigation procedures for any identified resources. To comply with these regulations, the Chairman of the Confederated Salish and Kootenai Tribes, the Kootenai Culture Committee and the Flathead Culture Committee were contacted (Historical Research Associates, Inc., 1989). An area of concern to Native Americans has been identified near the proposed Sedlak Park electrical substation.

Cultural Resource Site Types

Based on sites recorded in surrounding areas, the following cultural resource types were considered most likely to occur in the project area—prehistoric campsites, aboriginally scarred trees, historic cabins, trading posts, mining sites, logging sites, homesteads, bridges and trash dumps. The records and files search determined that 19 sites have been previously recorded within or near the project area, including two prehistoric sites, three scarred tree sites, and 14 historic sites.

At the time of the records check, one historic site (24LN786), the Swamp Creek Rural Historic District, was listed on the National Register of Historic Places (NRHP) (Historical Research Associates, Inc., 1989). At the present time, this site is no longer a historic district, but at least two of the structures are still considered eligible for the National Register of Historic Places (B. Timmons, Archaeologist, Forest, pers. comm., June 21, 1989). These resources are not located within any proposed area of impact and there would be no direct or indirect impacts (including visual) to them. Intensive survey of the permit area located two historic cultural resource sites (24LN942, and 24LN943) and no prehistoric or ethnohistoric resources. None of the newly recorded sites is considered eligible for nomination to the NRHP, and no further work is recommended. The Forest Service and the State Historic Preservation Office (SHPO) have concurred with these recommendations.

Detailed survey along the final centerline and access road locations for the transmission line would be necessary to fully evaluate presence or absence of historical or archaeological sites. For example, three historic properties on private lands along U.S. 2, the Schrieber homestead, the Wade Ranch and the Mannicke School, contain buildings which have been recommended as eligible for listing on the NRHP (Roeder and Heath, 1981), but have not been fully recorded or evaluated by the SHPO. KNF records also indicate that the historical Swamp Creek ranger station site and portions of the railroad used by the Libby Logging Company and the J. Neils Logging Company could be crossed by Alternative 6.

Recorded Cultural Resources

Site 24LN942 is a collapsed log cabin with remnants of a shed-style roof, located above Libby Creek. Features associated with the cabin include a trail connecting it to a two-track road, large stumps and cut logs, and a filled depression. The site is in poor condition due to natural deterioration. No additional substantive information can be gained from this site beyond that obtained during initial recording and photographic documentation.

Site 24LN943, located above Libby Creek, consists of four features—a collapsed, wood-frame residence, a collapsed pole-frame shed, a collapsed outhouse, and a dump. Based on the artifacts present at the site, it appears to be a logging camp last used in the 1950s. The site is in poor condition, and due to the lack of documentation for short-term logging camps, no further information can be gained from this site to that obtained during the initial recording and photographic documentation.

SOUND

Natural sound sources include wind, wildlife, waterflow, thunder, and wind-induced noise, such as the rustling of foliage. Other sound sources

include vehicles, such as trucks or airplanes, and man. The overall contribution from human activities, however, is small, and the predominant sound sources are natural.

Measured average daytime, nighttime and combined daytime and nighttime sound levels (L_d, L_n and L_{dn}) at two monitoring locations are presented in Table 3-42. Nighttime sound levels are 4 to 12 decibels [dB(A)] lower than daytime levels, due to cessation of many human related activities. Wind conditions during the monitoring period were low, less than 15 mph, eliminating wind as a significant sound source.

Table 3-42. Summary of ambient sound measurements.†

Measurement period	Little Cherry Creek	Ramsey Creek
Midweek		
Day (L_d)	39.0	41.3
Night (L_n)	35.5	28.8
L_{dn}	42.6	40.5
Weekend		
Day(L_d)	28.6	40.1
Night (L_n)	22.7	31.3
L_{dn}	30.6	40.6

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. S-1 to S-3.
†Equivalent sound level (L_{eq}) expressed as dB(A) re 20 µPa.

4

CONSEQUENCES OF THE PROPOSED ACTION AND ALTERNATIVES

THIS chapter discusses the anticipated impacts of the seven alternatives identified for the Montanore Project as described in Chapter 2. The nine alternatives evaluated are—

- Alternative 1–Noranda's proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3A–full lining of the impoundment and mechanical treatment of all excess water;
- Alternative 3B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Alternative 3C–alternative water management/land application treatment of all excess water.
- Alternative 4–Modified Miller Creek alternative transmission line routing;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action.

Alternatives 2 and 3 for the mine and Alternatives 4, 5 and 6 for the transmission line consist of Noranda's proposal with "mitigating measures", monitoring, alternative locations, or other actions that would be taken to reduce or eliminate the adverse impacts projected. All actions listed as mitigating measures were developed by the agencies and are not proposals by Noranda. These measures would be required by the agencies as a condition of issuance of permits described in Chapter 2, depending on the alternatives selected by the deciding boards and agencies. A separate section at the end of this chapter discusses the need for and reliability of the proposed transmission line. Following the discussion of the transmission line need and reliability is the agencies' analysis of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term resource productivity.

A discussion of cumulative impacts and irretrievable and irreversible commitment of resources follows the discussion of Alternatives 1 through 6. The

development, operation, closure and reclamation of the Montanore Project would require the irreversible or irretrievable commitments of various resources. These resources would either be consumed, committed, or lost during the life of the project and beyond. Nonrenewable resources, such as minerals in the ore, would be irreversibly committed during processing in the Montanore mill. A irretrievable commitment of resources occurs when resources, resource production, or the use of a renewable resource is lost because of land allocations, or a scheduling or management decision. Methods to protect natural resources that could be irreversibly affected by management decisions are incorporated into Alternative 2 where possible. No cumulative impacts and irretrievable and irreversible commitment of resources would be associated with Alternative 7.

AIR QUALITY

SUMMARY

All development alternatives would increase ambient concentrations of air pollutants; however, no established air quality standards would be exceeded. Ambient concentrations of metals in the air from the project area would be less than guideline values adopted by the state of Montana. Visibility in the area of the proposed project would also be affected similarly for all development alternatives. Emission plumes from the Libby Creek and Ramsey Creek adits would not exceed any established air quality visibility criteria . Noranda would implement an air quality monitoring program as a part of Alternative 2 and 3. Projected increases in emissions would not occur under Alternative 7.

ALTERNATIVE 1

Emission Sources

There would be four stationary sources of air pollutants in the proposed project—the Ramsey Creek adit, the Libby Creek adit, the Ramsey Creek plant site, and the tailings pond. Emissions from the Ramsey Creek adit would originate underground in the mine. Sources would include primary crushing, coarse ore conveying, blasting, diesel exhaust, and propane air heaters. Air emissions would be exhausted horizontally, with an expected flow rate of 700,000 cubic feet per minute.

The plant site would contain facilities for handling and grinding the coarse ore from the mine, and for handling the concentrate produced by the mill. Ore transfer by conveyor to a coarse ore stockpile, and wind erosion of the stockpile would be sources of dust emissions. No dust emissions are anticipated from the mill as the material in process would be kept wet. Some dust would be emitted from concentrate handling, but the amount would be minimized by maintaining a high moisture content.

Emissions from the Libby Creek adit would consist of dust from blasting, diesel exhaust, and combustion fumes from propane air heaters. Emissions from the Libby Creek adit would be exhausted vertically, at an expected flow rate of 700,000 cubic feet per minute.

The tailings from the mill would be gravity-fed to the tailings pond at Little Cherry Creek. As the slurry drains, part of the slime surface would dry out becoming a source of fugitive dust, mainly in the summer months.

Dust and diesel exhaust would be emitted to the air as a result of transmission line, access road construction/reconstruction and substation construction. The expected levels of emissions would be small tempo-

rary increases and would not affect air quality beyond the construction period.

Emission Estimates

Particulates. Noranda submitted computer modeled air quality information in the air quality permit application (TRC Environmental Consultants, Inc., 1989). Two models were used—the COMPLEX I model and the ISCST model. COMPLEX I was used to estimate impacts from the Ramsey Creek and Libby Creek facilities. In both cases, the model receptor grid included all locations expected to have high concentrations of particulates from these two sources. Receptors also were located along the boundary of the Cabinet Mountains Wilderness due to the sensitivity of its Class I airshed. Receptor grids are shown in the air quality permit application (TRC Environmental Consultants, Inc., 1989). For the tailings pond, particulate impacts were estimated using the ISCST model. The models have been approved by the Environmental Protection Agency and the Montana Air Quality Bureau.

All model runs predicted particulate (PM-10) concentrations well below federal and Montana ambient air standards (Table 4-1). Emissions are measured in micrograms per cubic meter of air (μg/m³). Highest increased particulate concentrations (24-hour) would occur near the plant site outside the wilderness (33.6 μg/m³). However, when added to the background concentration of 35.0 μg/m³, the increased particulates would result in a maximum 24-hour concentration level during mining of 68.6 μg/m³, less than one half of the applicable standard of 150 μg/m³.

The predicted concentration assumes paving of the main access road (Bear Creek Road) and does not consider other pre-operational construction activities. Emissions, especially particulates, would be higher during the construction phase than during the operations phase. Prior to road paving, Noranda would be required to control particulate emissions through water and other control techniques. The agencies would monitor Noranda's control practices through inspection and visual observations.

Particulate emissions in pristine areas such as the Cabinet Mountains Wilderness are covered by the ambient air standards, and by standards establishing the maximum allowable increase (increment) above the background concentration (i.e., Prevention of

Table 4-1. Maximum predicted particulate (PM-10) concentrations and applicable standards.

Area	Averaging time	Predicted concentration (μg/m³)	Background concentration (μg/m³)	Predicted plus background (μg/m³)	Applicable standard (μg/m³)
Plant site	Annual	3.8	10.6	14.4	50
	24-hour	33.6	35.0	68.6	150
Libby Creek adit	Annual	0.7	10.6	11.3	50
	24-hour	5.3	35.0	40.3	150
Cabinet Mountains Wilderness					
(from plant site)	Annual	0.7	10.6	11.3	50
	24-hour	9.0	35.0	44.0	150
(from Libby Ck. adit)	Annual	<0.1	10.6	10.6	50
	24-hour	0.8	35.0	35.8	150
Tailings impoundment area	Annual	4.0	10.2	14.2	50
	24-hour	8.2	28.0	36.2	150

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-10.

Significant Deterioration [PSD]) standards. Although the PSD standards would not be applicable to the Montanore Project, many of the specific PSD requirements would be met. These include pre- and post-construction ambient monitoring, computer simulation modeling of emission impacts, an analysis of visibility impacts, and the application of Best Available Control Technology (BACT) to emission sources. The maximum modeled particulate impacts would be equivalent to 90 percent of the 24-hour increment and 13 percent of the annual increment. These are below the PSD levels for Class I (wilderness) areas.

Nitrogen Oxides

Ramsey Creek. To simplify the modeling of nitrogen oxide emissions from the Ramsey Creek adit, annual impacts were modeled assuming 100 percent conversion of all nitrogen oxides to nitrogen dioxide (NO_2), a method that overestimates impacts over the course of a year. On this basis, the annual NO_2 level was 10.9 $\mu g/m^3$, predicted along the northern edge of the permit boundary (Table 4-2).

The federal ambient air standard for NO_2 applies only to annual average concentrations; Montana has a 1-hour standard. In modeling the maximum 1-hour impact, the maximum NO_2 concentration predicted by modeling was modified to account for partial conversion of other NO_2 compounds to NO_2, using a procedure recommended by the EPA in its modeling guidelines (EPA, 1986). The maximum predicted 1-hour NO_2 emission level is 225.3 $\mu g/m^3$ (Table 4-2). A separate model run was made to predict impacts in the Cabinet Mountains Wilderness. The maximum predicted annual concentration in the wilderness is 1.9 $\mu g/m^3$ from the Ramsey Creek adit, and 0.67 $\mu g/m^3$ from the Libby Creek adit. These concentrations compare to an allowable PSD Class I increment of 2.5 $\mu g/m^3$ (78 percent of the allowable increment). The maximum annual impact of 18. 2 $\mu g/m^3$ (Table 4-2) from the Libby Creek adit compares with the allowable Class II increment of 25 $\mu g/m^3$ (73 percent).

Libby Creek. Using the same methods discussed for Ramsey Creek, the maximum predicted average annual NO_2 emission levels in Libby Creek is 18.2 $\mu g/m^3$ at a receptor north-northeast of the Libby Creek portal on the permit boundary. The predicted 1-hour maximum NO_2 concentration is 250.8 $\mu g/m^3$ (Table 4-2). The predicted annual concentration in the Cabinet Mountains Wilderness is 0.7 $\mu g/m^3$. All predicted emission levels are below standards.

Carbon Monoxide

As with nitrogen dioxide, the Libby Creek and Ramsey Creek adits would be the primary carbon monoxide sources for the proposed project. For both sources, modeling was performed using the same model, COMPLEX I, and the same receptor array as was used for particulates and NO_2. Although the impact prediction method for NO_2 and carbon monoxide (CO) is the same, there are no

Table 4-2. Predicted nitrogen dioxide concentrations and applicable standards.

Area	Averaging time	Predicted concentration	Background concentration	Predicted plus background	Applicable standard
		$\mu g/m^3$			
Plant site	Annual	10.9	3.2	14.1	100
	1-hour	225.3	92.5	317.7	566
Libby Creek adit	Annual	18.2	3.2	21.4	100
	1-hour	250.8	92.5	343.2	566

Source: TRC Environmental Consultants, Inc. 1989. V. 1, p. 6-13.

background concentrations available from baseline monitoring data or other sources. The predicted concentrations are very small compared to ambient air standards, so the project's emissions would not likely cause or contribute to an air quality problem with respect to CO (Table 4-3).

Lead

Predicted 24-hour maximum lead concentrations are 0.04 μg/m³ at the tailings pond and 0.2 μg/m³ at the Ramsey Creek plant. These concentrations are higher than a monthly average would be, but would not exceed federal and Montana ambient air standards.

Non-criteria Pollutants

Non-criteria pollutants are those which are regulated, but have no ambient air standard. The Montana Air Quality Bureau has adopted guideline concentration values for a number of metals—arsenic, antimony, cadmium, chromium, zinc, copper and iron. For all pollutants in this category, modeled concentrations are less than the adopted guidelines (Table 4-4).

Table 4-3. Predicted concentrations and applicable standards for carbon monoxide.

Location	Averaging time	Predicted concentration (μg/m³)	Montana standard (μg/m³)
Ramsey Creek	8-hour	153	10,000
	1-hour	354	26,437
Libby Creek	8-hour	560	10,000
	1-hour	1,134	26,437

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-14.

Table 4-4. Predicted metals concentrations and applicable standards.

Metal	Averaging time	Predicted concentration (μg/m³)	Background concentration (μg/m³)	Predicted plus background (μg/m³)	Applicable standard (μg/m³)
Antimony	24-hour	0.00067	0.003	<0.01	3.93
	Annual	0.00008	0.001	<0.01	0.65
Arsenic	24-hour	0.00672	0.003	0.01	0.39
	Annual	0.00075	0.001	<0.01	0.07
Cadmium	24-hour	0.00067	0.0	<0.01	0.39
	Annual	0.00008	0.0	<0.01	0.07
Chromium	24-hour	0.00101	0.006	0.01	0.39
	Annual	0.00011	0.003	<0.01	0.07
Copper	24-hour	0.22841	0.138	0.37	1.57
	Annual	0.02557	0.080	0.11	0.26
Iron	24-hour	0.17131	5.640	5.81	7.86
	Annual	0.01918	0.204	0.22	1.31
Zinc	24-hour	0.00034	0.097	0.10	39.27
	Annual	0.00004	0.007	0.01	6.55

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-16 through 6-20.

Visibility

An estimate of the proposed project's effect on visibility from and within the Cabinet Mountains Wilderness was made following the procedures of the EPA document, *Workbook for Plume Visual Impact Screening and Analysis* (EPA, 1988). These procedures incorporate a staged analysis approach. An initial screening procedure, referred to as Level 1, uses assumptions that tend to overestimate the impacts, but is relatively simple to perform. If the Level 1 result shows a significant impact, a Level 2 analysis is performed. The Level 2 procedure uses inputs based on local meteorology and source operation, rather than worst-case assumptions, and therefore produces more realistic impact estimates. Details on the model, input data and results are contained in Noranda's air quality application (TRC Environmental Consultants, Inc., 1990b) and a visibility impact assessment report (TRC Environmental Consultants, Inc., 1990c). Modeling procedures are described in greater detail in Chapter 6.

Modeling results for Level 1 visibility screening showed no significant impact within the wilderness due to emissions from the tailings pond. Emissions from both the Ramsey Creek and Libby Creek adits, however, were predicted to cause impacts within the wilderness. Impacts outside the wilderness were not considered, as no integral vistas have been designated. The more sensitive Level 2 analysis of project emissions predicted no significant impacts for any source for any view within the Cabinet Mountains Wilderness (see Chapter 6 for description of analysis).

Plume Interaction

The Ramsey Creek adit, the Libby Creek adit, and the tailings pond were modeled to estimate combined particulates emission impacts. The predicted maximum particulate concentrations from all sources are not expected to be more than those modeled for the Ramsey Creek facilities alone (Table 4-5). Nitrogen oxides emissions from Libby Creek and Ramsey Creek were similarly modeled. Model results indicate that combined emissions would not be greater than those predicted from the Libby Creek adit alone. Based on these results, little plume interaction would be expected to occur in the area.

Emissions impacts to the town of Libby were predicted to determine the estimated maximum PM-10 concentrations. The maximum annual average PM-10 concentration at Libby was predicted to increase 0.001 $\mu g/m^3$, and maximum predicted 24-hour increase was 0.01 $\mu g/m^3$. Both predicted impacts are much smaller than the PM-10 "significant" concentrations limit standards of 1.0 $\mu g/m^3$ (annual) and 5.0 $\mu g/m^3$ (24-hour).

Secondary Impacts

Air quality impacts from growth of population could occur in Libby. It is estimated that the peak

Table 4-5. Projected combined particulate concentrations and applicable standards.

Pollutant	Averaging time	Predicted concentration ($\mu g/m^3$)	Background concentration ($\mu g/m^3$)	Predicted plus background ($\mu g/m^3$)	Applicable standard ($\mu g/m^3$)
PM-10	Annual	3.8	10.6	14.4	50
	24-hour	33.6	35.0	68.6	150
Nitrogen dioxide	Annual	18.3	3.2	21.5	100
	1-hour	250.8	92.5	343.3	566

Source: TRC Environmental Consultants, Inc. 1990a. Addendum 1, pp. 13-15.

population increase would occur in 1995 and the development would cause an additional 411 people to move to Libby, or rural areas near Libby. To accommodate this increase in population, the number of housing units would also increase (see *Socioeconomics* in this chapter). Assuming that the population growth is directly related to emissions from wood burning fireplaces and stoves and motor vehicle traffic, it is estimated that the resulting PM-10 average concentration in Libby would increase from 64 $\mu g/m^3$ to 67 $\mu g/m^3$ and the maximum 24-hour value would increase from 256 $\mu g/m^3$ to 270 $\mu g/m^3$ if no air pollution mitigations were applied.

Although direct impacts from the proposed project would be small, secondary impacts related to population growth might cause increased costs to the local government. This potential impact would be addressed through the Hard Rock Mining Impact Plan described in Chapter 1 and the *Socioeconomic* section in this chapter.

The Libby Air Quality Advisory Committee is developing an air quality compliance plan to reduce PM-10 levels in Libby. Measures that have been adopted include wood burning restrictions during poor dispersion conditions, requiring all new wood stoves to be certified clean burning, using road sanding material with fewer fine-textured particles, reducing road sanding, and reducing emissions from the Champion International operations.

Air Emissions Control Measures

Noranda has identified equipment and facility practices to control or minimize air emissions (Table 4-6). The control measures proposed include—

- watering and revegetating during construction activities;
- using proper maintenance practices for diesel equipment and particulate traps to remove particulates;
- using propane fuel rather than wood or oil for space heating;
- installing a high efficiency wet scrubber system to reduce dust from the primary crusher;
- using a high efficiency wet scrubber during ore transfer;
- paving the main access road (from U.S. 2 to the plant site);
- installing sprinklers to keep tailings impoundment material wet; and
- enclosing the rail siding at Libby.

The control efficiencies for each of these measures were estimated (where appropriate) based on experience for similar mines and mills (Table 4-6). The expected major sources of particulates are unpaved roads and the tailings impoundment. Paving the Bear Creek access road would significantly reduce particulate emissions in the area. Emissions from other roads used as part of the project operation would be controlled on an as-necessary basis, probably through watering and/or chemical stabilization.

The proposed tailings sprinkler system would reduce particulates by an estimated 50 percent. Prior to operations, Noranda would submit to the agencies a general erosion control plan for the tailings impoundment. The plan would include a site plan with embankment and cell (if any) configurations, general sprinkler arrangement, and a narrative description of the operation, including tonnage rates, initial impoundment area and timing of future enlargements. The effectiveness of Noranda's proposed wind erosion control measures would be evaluated by the agencies through a periodic review of air quality monitoring data and occasional visual observations. If the proposed erosion control measures are determined by the agencies to be inadequate, a more detailed mitigation plan would be required. The following additional measures would be considered—

- establishment of a temporary vegetative cover on portions of the tailings surface and embankment;
- chemical stabilization of some areas;

Table 4-6. Proposed control equipment and practices—Montanore Project.

Source/ activity	Pollutant	Uncontrolled emissions (tons/year)	Type of control equipment/practice	Estimated control efficiency	Controlled emissions (tons/year)
Construction	TSP/metals	—	Watering haul roads and work areas	—	—
			Topsoil storage revegetation		
			Regulate slash burning		
Blasting	TSP/metals	0.5	Stemming, drill hole size optimization	—	0.5
			Rubble watering	—	
	NO_2	46.2	Control overshooting	—	46.2
	SO_2	4.8	Control overshooting	—	4.8
	CO	169.3	Control overshooting	—	169.3
Diesel equipment	TSP	4.8	Particulate matter trap renewal	—	4.8
	NO_2	153.5	DITA engines[†]	40%	92.1
	SO_2	17.2	Low sulfur diesel oil	—	17.2
	CO	21.4	Frequent tune-ups to manufacturer's specs	—	21.4
	HC	7.3	Routine fuel delivery and burner system evap. cont. system maintenance	—	7.3
Space heating	TSP	0.1	Use propane, routine maintenance schedule	—	0.1
	NO_2	2.2	Maintain near-stoichiometric atmosphere	—	2.2
	CO	0.5	Maintain near-stoichiometric atmosphere	—	0.5
	HC	0.1	Routine fuel delivery and burner system Inspection/renewal	—	0.1
Primary crushing	TSP/metals	56.9	High efficiency wet scrubber	95%	2.8
Conveyance, transfer, storage of ore and concentrate[§]	TSP/metals	6.1	Partial enclosure	—	6.1
Mill	TSP/metals	35.6	High efficiency wet scrubber	95%	1.8
Road dust	TSP	5.1	Chip and seal	—	5.1
Tailings impoundment	TSP/metals	34.6	Sprinklers	50%	17.3

Source: DHES. 1991. p. 3
[†]DITA–direct injection turbo-charged aftercooling
[§]This represents a combination of sources; the emission points are conveying and storage of coarse ore and concentrate.

- development of a more extensive sprinkler system to provide more coverage and greater water availability; and
- development of a detailed sprinkler operating plan.

Noranda would retain the responsibility to minimize wind erosion emissions during any temporary curtailment of operations, and during the period following mining and before final reclamation. The mitigation measures used during operations would be used. If watering would not be feasible due to the need to dry the tailings for reclamation purposes, the other measures would be necessary.

The proposed control equipment and facility practices are Best Available Control Technology (BACT) and represent reasonable control measures. Proposed interim reclamation plans for many disturbed areas also would reduce fugitive dust emissions. Ambient air quality and meteorological monitoring near the mine/mill and tailings area would be required.

A specific air quality concern is the potential for wind erosion from the tailings impoundment area. If tailings surfaces are allowed to dry, there is a significant potential for wind erosion to occur given the fine texture of tailings material. The impoundment would be designed so that one third of the surface would be completely submerged at all times. A water-sprinkling system would be used to wet exposed surfaces and natural precipitation also would provide some measure of control. The factors noted previously, as well as expected meteorological conditions, were used in estimating wind erosion emissions. Even with these controls, it would be expected that some wind erosion would occur during high wind conditions; however, particulate levels should remain well below the applicable ambient air quality standards. The overall efficiency and adequacy of the proposed controls would be evaluated through the periodic review of air quality monitoring data and occasional visual observation of the operation by the agencies.

In the event that the proposed erosion control measures are determined by the agencies to be inadequate, other wind erosion control measures which could be implemented include—

- establishment of a temporary vegetative cover on portions of the tailings surface and embankment;
- chemical stabilization of some areas;
- upgrading of the sprinkler system to provide more extensive coverage and water availability; and
- development of a detailed sprinkler operating plan which would be frequently updated as the tailings surface expands. (This might include specific record-keeping requirements such as times of sprinkler operation and the amount of water applied and development of a minimum threshold wind speed criteria above which sprinkling might be required.)

ALTERNATIVE 2

Noranda would institute the air monitoring program described in detail in Appendix B. Implementation of the monitoring program would ensure emissions levels expected under Alternative 1 are effectively controlled throughout the project life.

ALTERNATIVE 3

If land application of the treated water is not used, gaseous and particulate emissions which would occur during construction in these areas would be reduced. Such emissions would be limited and their reduction would not significantly affect air quality. Construction of additional LAD areas is another option under Alternative 3. Such construction would result in an insignificant increase in gaseous and particulate emissions. Other impacts would be the same as those described for Alternatives 1 and 2.

ALTERNATIVES 4, 5 AND 6

With the exception of short-term increases in gaseous and particulate emissions during construction, the transmission line operation would not affect air quality.

CUMULATIVE IMPACTS

All action alternatives would have similar cumulative impacts. Projected timber harvesting and timber hauling on unpaved roads would increase particulate emissions for a short duration. Environmental assessments of timber sales would evaluate air quality issues prior to sale approval.

The ASARCO Rock Creek project is proposed on the west side of the Cabinet Mountains in the Rock Creek drainage. Emissions sources would be associated with the plant site, tailings impoundment and other surface disturbances. ASARCO also proposes to use diesel equipment in the mine and vent mine exhaust northeast of the plant site.

Although an intake ventilation adit would be located in the Cabinet Mountains Wilderness, it would not be a source of emissions.

The dominant wind direction at ASARCO's proposed tailings impoundment site is divided equally between up-valley winds and down-valley winds. Wind patterns at ASARCO's proposed plant site are expected to be similar. During down-valley air flows, no cumulative impacts are expected. During up-valley wind direction, dilution of emissions would likely reduce ASARCO's emissions to below detectable levels at Noranda's air monitoring locations.

The air quality permit application review for ASARCO's proposed Rock Creek Project is ongoing. Similar to the Montanore Project, it is not a major stationary source; therefore, there would be no particulate increment consumption. Nitrogen dioxide and sulfur dioxide increment consumption would occur from both projects, but the analysis indicates that there would not be a combined or overlapping increment consumption. Nitrogen dioxide emissions from fuel burning associated with timber production would consume increment and could have a combined effect with respect to the Montanore Project. It is unlikely that these activities would consume the entire increment but this would be reviewed on an ongoing case-by-case basis. Cumulative air quality impacts should not approach ambient standards. Through the air quality permitting process, including Prevention of Significant Deterioration provisions, future projects could be denied based on their additive impacts relative to ambient standards and increments.

RESOURCE COMMITMENTS

During construction and operation of the mine, air pollutant concentrations would be higher throughout the project area and in the Cabinet Mountains Wilderness than current levels, but below applicable air quality standards. During operations, Noranda's emissions would irretrievably consume nitrogen dioxide and sulfur dioxide increment within the Cabinet Mountains Wilderness. Following mine closure and successful reclamation, pollutant concentrations would return to pre-mining levels. There would be no long-term irreversible or irretrievable commitment of resources.

ALTERNATIVE 7

The increased air emissions from mine construction and operation described under Alternative 1 would not occur. The ambient air quality in the Cabinet Mountains Wilderness would not change.

GEOLOGY AND GEOTECHNICAL

SUMMARY

Construction of project facilities would alter the existing topography and surface water drainage system at the plant site and the tailings impoundment area. Construction of substations and roads would alter the existing surface water drainage in minor ways. The most significant alteration of the existing topography would be the construction of the tailings impoundment. The tailings impoundment would remain as a permanent landform in the lower Little Cherry Creek valley.

Stability analyses indicate the tailings embankment would remain stable even in the event of a maximum credible earthquake. Artesian conditions at the impoundment site would be controlled using an initially passive pressure relief system that would be augmented through

installation of well pumps if necessary. These measures would reduce artesian pressures from affecting embankment stability, and increase interception of subsurface seepage.

No landslide areas or areas of slope instability have been identified in the area of the mine, adits, tailings impoundment site or the Sedlak Park substation. Areas of steep, possibly unstable slopes occur along the transmission line routes. Avalanche areas in the Ramsey Creek drainage could pose a hazard to the transmission line and tailings pipelines. Mining should result in no subsidence of the overlying surface. Areas of the deposit potentially susceptible to subsidence would either not be mined or would include measures to prevent subsidence. Alternatives 2 and 3 would include some additional monitoring. Noranda would institute monitoring designed to evaluate the geotechnical and hydrological conditions near Rock Lake and the Rock Lake Fault. The transmission line alternatives (4, 5, and 6) would have little effect on geological resources. Under Alternative 7, the proposed landscape modifications would not occur. The Libby Creek adit would be reclaimed in accordance with the exploration permit issued by the DSL.

ALTERNATIVE 1

Topography and Geomorphology

Libby Creek and Ramsey Creek facilities. Construction of surface facilities for the Montanore Project would alter the existing topography and surface drainage system. Existing disturbance at the Libby Creek adit area (19 acres) includes cut-and-fill benches, a temporary waste rock pile, and a land application disposal area. The waste rock would eventually be used for construction of the tailings impoundment. At the end of operations, the land application disposal area would be filled and waste rock from the bench would be backfilled into the adit for closure. Except for a small bench (less than 3 acres) that would remain following mining operations, the post-mining topography would approximate pre-mining conditions.

The Ramsey Creek portal and plant site (45 acres) also would be constructed using a cut-and-fill sequence with the fill supplemented with waste rock from adit construction. Cut slopes would be benched at 15- to 25-foot intervals. Following operations, the mine portal would be backfilled to the approximate original topography. Benches for the mill, electrical substation, and thickener would remain. All drainage and diversion structures used during the operational period at the mill site would be removed and the pre-mining drainage restored. Drainage on the remaining fill material would be riprapped if necessary to control erosion.

Land application disposal and waste rock storage areas. Two land application disposal (LAD) areas and a temporary waste rock pile (about 80 acres of surface disturbance) would be constructed adjacent to lower Ramsey Creek. The stockpile site would be reclaimed to its pre-operational topography. If construction requirements do not exceed waste rock production, or if more economical borrow material becomes available, one or more waste rock storage areas would remain as a permanent feature following mining operations.

A 10-acre pond would be constructed to store water at the LAD area. The pond would slightly modify the existing hillslope. Following operations, the pond would be regraded.

Tailings impoundment. The most significant alteration of existing topography would be construction of a 460-acre tailings impoundment. The impoundment dam would have a maximum height of 370 feet.

The tailings impoundment would remain as a permanent landform following mining operations.

Diversion channel stability. Because the diversion channel would cross a hillslope, channel failure and flooding could occur. The design of the diversion would make overtopping of the channel banks unlikely. Excessive sediment deposition within the diversion channel would be unlikely, due to the steep slope within the channel.

If excessive sedimentation were to occur, however, this condition could eventually lead to overtopping and failure of the diversion channel. Should this occur, flow would probably follow the topographic low between the natural topography and the southern boundary of the tailings pond toward the unnamed tributary of Libby Creek. This would probably result in erosion of the south saddle dam. In such an event, stability of impoundment and release of tailings in Libby Creek would depend on the amount of erosion of the impoundment dams.

The diversion of additional flow into the unnamed tributary of Libby Creek would potentially result in increased erosion and channel down-cutting in the tributary and transport of sediment into Libby Creek. To minimize this potential for erosion in the natural stream channel, rockfill bars would be constructed perpendicular to the channel at the end of operations.

Transmission line. Construction of the transmission line would result in minor alteration of the existing topography and surface water drainage at structure sites and roads. Construction of the Sedlak Park substation would require diversion of Sedlak Creek, an intermittent stream. The substation would be located to minimize the diversion of Sedlak Creek and associated channel disturbance. Some relocation of Sedlak Creek would be required to avoid more extensive disturbance from cut-and-fill construction to place the substation at the site. Following reclamation at the end of the transmission line's useful life, topography and surface drainage would approximate existing conditions.

Tailings Impoundment Stability

Tailings embankment. The tailings dam would be built using downstream construction methods. This method is generally considered as the most stable tailings impoundment construction method. The calculated safety factors under static and seismic conditions indicate stability of the starter dam and final tailings embankment and exceed the generally accepted minimum values (Morrison-Knudsen Engineers, Inc., 1989a; 1990a.). The tailings embankment would remain stable during construction and operation even in the event of the Maximum Credible Earthquake (MCE). For this project, the MCE was determined to be an earthquake having a magnitude 7.0 on the Richter Scale originating on the Bull Lake Fault, located about 12 miles west of the impoundment site.

Static and pseudostatic (seismic) stability analyses of the tailings embankment were conducted independently by the agencies, (see Chapter 6 for analysis). This analysis generally concurred with the analysis conducted by Noranda. Chapter 6 discusses the stability analysis methods.

The tailings embankment stability would be enhanced by inclusion of a gravel blanket drain, filter zones, a rockfill zone, and two trunk drains as proposed by Noranda (see Figure 2-11). The combined action of the blanket drain, filters, rockfill, and trunk drains would be to lower the phreatic water surface within the embankment by intercepting seepage, increasing overall impoundment stability.

Tailings embankment foundation. The density of foundation soils under the proposed tailings embankment would be sufficient to preclude the occurrence of liquefaction (loss of soil strength during seismic shaking) in the event of the Maximum Credible Earthquake. The stiffness of the foundation soils would preclude the occurrence of excessive settlements of the embankment foundation.

Some consolidation and settlement of foundation soils would occur beneath the dam. Settlement is

expected to be in the order of several feet. The degree of compression and decrease in permeability of the dense, primarily coarse-grained strata and subsurface flow channels generally would be very small. The coarse grained flow paths for the artesian ground water would not be pinched off and would remain largely unaffected by the applied embankment stresses.

Artesian ground water conditions have been identified within the area proposed for the tailings embankment and impoundment. Current artesian pressure is low and would not be expected to adversely affect dam stability. Artesian conditions, however, might increase in magnitude during the project life as a result of seepage from the impoundment. This condition would have a detrimental effect on the embankment stability, due to the development of uplift pressures within the embankment foundation, resulting in a loss of embankment or foundation soil strength and possible instability.

Noranda proposes to use a system of wells to relieve artesian water pressures. An adequately designed pressure relief system would relieve artesian pressure and ensure embankment stability during the construction, operating and post-operating periods. The agencies believe, however, that a more conservative approach is needed during the initial construction and operation phase than that proposed in Noranda's conceptual design. It is during the initial construction and operation phase that the embankment would be most sensitive to the effects of artesian pressure within the foundation soils.

Subsidence

Subsidence is the surface expression that results from collapse of underground openings, such as those created by underground mining. Noranda's proposed plans include using a room-and-pillar mining method. Preliminary plans are to leave 30 to 40 percent of the ore in place as pillars to support the mine workings. Underground collapse could occur if pillars are too small to support the load of overlying rocks, or if the pillars are too widely spaced to provide sufficient roof support. Underground mine failures often occur in room-and-pillar mines without leading to subsidence. A number of factors determine if such failures lead to subsidence. Factors include the type and extent of failure, the strength and thickness of rocks overlying the mine, and the presence or absence of continuous geologic structures.

Existing geotechnical information and preliminary mine plans were used to evaluate the potential for surface subsidence. Presently, there is not sufficient geotechnical information to develop a mine design that completely addresses the long-term subsidence issue. This lack of information occurs in the preliminary stages of all new mining operations. Mine design is an evolutionary process—preliminary mine designs are developed, and then ground conditions experienced during initial development are used to check the preliminary design. Modifications are then made as necessary to provide for long-term stability.

Two major modes of surface subsidence are associated with mining—sinkhole and trough. Sinkhole, or "chimney", subsidence is characterized by surface fracturing and sinking. It results from sudden or intermittent collapse of the overburden roof in localized areas, and may range in diameter from several feet to tens of feet. A "chimney" or "plug" of broken rock develops from the mine level to the surface. Extensive experience from room-and-pillar coal mines indicates that sinkhole subsidence occurs mostly in overburden less than 180 feet. There are, however, documented cases of sinkhole subsidence occurring through overburden depths of as much as 1,800 feet which are caused by intersection of the mine with continuous structure planes, such as faults.

Noranda's mine design at Montanore includes pillars providing full overburden pillar support and larger pillars being left near large faults. The mine would extend from 500 to about 3,800 feet below the surface. Thus, the probability of large caves developing and intersecting with large geologic structures, lead-

ing to sinkhole subsidence, would be extremely small if planned geological and rock mechanics programs are implemented. Case study experience indicates that the potential for sinkhole subsidence is negligible with the proposed mining plan.

Trough subsidence is characterized by the formation of a basin, usually without continuous fracturing from the mine to the surface, and with much less fracturing than sinkhole subsidence. This form of subsidence is elliptical in plan view and occurs over large areas, typically from hundreds to thousands of feet in breadth.

Three zones are usually present with trough subsidence [Peng and Chiang, 1983 *in* Agapito (1991)]. These are: 1) a caved zone from the immediate roof with a height approximately equal to 2 to 8 times the mining height; 2) a fractured zone that can be as high as 30 to 50 times the mining height; and 3) a deformation zone from the top of the fractured zone to the surface.

One method used to predict trough subsidence is based on the width-to-depth ratio of a mining section or panel and the mining height. Experience indicates that the amount of subsidence decreases with an increase in the proportion of strong rocks in the overburden [Peng and Cheng, 1981; Karmis et al., 1981; and Jeran et al., 1986 *in* Agapito (1991)]. Rocks overlying the deposit generally are considered strong. If trough subsidence were to occur at Montanore, it probably would not exceed more than 10 to 20 percent of the mine height. That is, trough subsidence probably would not exceed 6.4 to 12.8 feet, assuming an average total mine height of 64 feet. This worst case scenario assumes widespread pillar failure, which is considered unlikely and could be avoided with adequate mine design.

As previously discussed, rock mechanics design is an evolutionary process. Noranda has developed a preliminary design and would modify this design, as needed in response to actual underground conditions. The agencies have reviewed Noranda's preliminary design and have several concerns about the design. The agencies' concerns include the possible need for increased safety factors and pillar widths in certain areas, and the possibility of shear failure of the roof along pillar edges due to high pillar stresses at depth. Underground geotechnical information is required to adequately address these issues. Noranda has committed to an ongoing geotechnical program to identify such potential problems prior to their occurrence (Noranda Minerals Corp., March 27, 1991). Collecting underground geotechnical information is part of Noranda's activities after completing the Libby Creek adit. Noranda would immediately notify the agencies of any conditions that have significant impacts on mine design or that would affect the conclusions of the existing geotechnical evaluation. Noranda would implement changes in the mine design to avoid subsidence or conditions that could lead to massive failure.

In summary, the potential for sinkhole subsidence would be negligible. The potential for trough subsidence is a function of the mine design. The best way to reduce or eliminate this potential would be by proper sizing and location of pillars and by proper sizing of roof spans and location of roof horizons. Evaluation of the preliminary mine plan indicates the possible need to increase pillar widths in certain areas, and concern about possible shear failures of the roof along pillar edges.

Landslides, Slope Stability, and Avalanches

No landslide areas or areas of slope instability have been identified in the area of the mine, adits, tailings impoundment site and the Sedlak Park substation. Localized slope failures are known to exist along the transmission line routes and might result from road cuts associated with new road construction in areas prone to slope failure. The effects of these problems for the transmission line alternatives are discussed in greater detail in the *Surface Water Hydrology* section. Should slope failures in road cuts occur, they would have to be evaluated and mitigated on a case-by-case basis.

Avalanche areas in the Ramsey Creek and upper Libby Creek drainages have been identified. In Ramsey Creek, no avalanche chutes were identified at the Ramsey Creek plant site. A short avalanche chute, occurring near the Ramsey Creek adit, should not affect operations. Avalanches may pose a hazard to the transmission line near the mouth of Ramsey Creek. Poles would be located to avoid avalanche chutes, but wind blasts caused by avalanches could knock the line out of service. Access roads to the plant site and to the Libby Creek adit also would be susceptible to avalanches originating on the north side of the valley. No other avalanche hazards are known to exist outside these drainages.

Geologic Resources

Current ore reserves are estimated at about 135 million tons at an average grade of 1.93 ounces of silver per ton and 0.74 percent (~15 pounds per ton) copper (Noranda Minerals Corp., 1991). Actual reserves in the deposit to which Noranda has a valid right to mine may be higher or lower than the estimated amount. The Montanore Project would remove 60 to 70 percent of the ore. The remaining 30 to 40 percent would remain in pillars to provide structural support to the mine workings. The ability to recover the remaining ore would depend on metal prices and the structural modifications necessary to mine the pillars.

Placer gold has been mined at lower elevations from unconsolidated valley fill deposits along Libby Creek and tributary drainages. Some placer mining, primarily recreational, continues along these drainages today. Except for the construction of the Little Cherry Creek tailings impoundment, the proposed mining operations would not affect the long-term availability of the placer deposits in the project area. Construction of the tailings pond could prevent access to placer deposits should any occur in the tailings pond site. However no known placer or other mineral deposits exist beneath the tailings impoundment site (Noranda Minerals Corp., 1991). The only placer mining known to occur in the Little Cherry Creek drainage was located near the confluence with Libby Creek, where gold deposits are covered with thick fill, limiting economic recovery potential (Johns, 1970).

ALTERNATIVE 2 AND 3

These alternatives require Noranda to provide the agencies with an updated mine design within two years of operation (after mill startup). The agencies would have a mine engineer review the design and inform the agencies of any potential problems that could lead to subsidence. The purpose of this review would be to verify conclusions reached on the preliminary mine design. Although it is not the intent to dictate design standards to Noranda, the agencies may request modification of the mine plan if significant problems are noted that could lead to surface subsidence and resultant effects to ground water.

Noranda would institute the tailings dam and impoundment monitoring program described in detail in Appendix B. This program is designed to evaluate the stability of the tailings dam throughout the life of the project.

The agencies would require Noranda to provide a more conservative approach as part of final design of the pressure relief well system. Before final design, Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a redundant ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigations would provide more detailed information on artesian pressures within the embankment area.

ALTERNATIVES 4, 5 AND 6

Location and construction of the Sedlak Park substation to avoid rerouting or disturbance adjacent to Sedlak Creek would not be possible given the size of the required substation and the limitations of the site. Additional detailed engineering survey and

substation design work by the agencies would incorporate best management practices to minimize effects from construction at this site. Impacts at the Sedlak Park substation would be the same as Alternative 1.

Selection of an alternative transmission line route would not alter the geological impacts of the mine, adit, or tailings impoundment described in Alternative 1.

CUMULATIVE IMPACTS

Both Noranda's Montanore Project and ASARCO's Rock Creek project would mine strataform copper and silver deposits from metasedimentary rock. Estimated mineable reserves for the two projects total 195 million tons of ore.

Besides the Montanore Project ore body, the project area contains mineral resources, such as silver, lead, zinc and gold, which have been mined from numerous small underground mines and placer operations in the past. These resources are primarily located in the higher elevations in the Cabinet Mountains and would not be affected by the proposed operations. Although some of these claims lie within the boundary of the Cabinet Mountains Wilderness, most are outside. While exploration and development of these deposits might be technically feasible, the Montanore Project, while in operation, might preclude such activities because of grizzly bear habitat or other resource limitations. A Biological Assessment and NEPA analysis for future surface disturbing mineral activities would be required by the KNF prior to approval.

RESOURCE COMMITMENTS

Assuming 67 percent mine recovery and including dilution, approximately 95 million tons of ore would be removed by the Montanore Project, with about 40 million tons of ore left for structural support of the mine workings. Actual reserves in the deposit to which Noranda has a valid right to mine may be slightly higher or lower than the estimated amount. Considering losses in mill recovery, approximately 160 million ounces of silver and 615,000 tons of copper would be recovered from the operation. Other metals in the ore could not be economically recovered. Any precious metals in the alluvium which would be covered by the tailings impoundment would be lost permanently. Construction and operation of the Montanore Project would result in the irreversible commitment of these resources.

The tailings impoundment would be a permanent facility. Construction of the impoundment and associated dams would irreversibly alter the topography in the impoundment area. Construction of the plant site would irreversibly alter the topography in the plant site area.

ALTERNATIVE 7

If the proposed permit is denied, the effects discussed in Alternatives 1 through 6 would not occur. Potential acid generating materials would not be brought to the surface, nor would potential acid generating materials be placed in an oxidizing environment underground. Approximately 95 million tons of silver and copper ore would remain in place underground. The Libby Creek adit would be reclaimed in accordance with the exploration permit issued by the DSL.

SURFACE WATER HYDROLOGY

SUMMARY

Under Alternative 1, surface disturbances associated with the Montanore Project would affect about 1,270 acres in the Libby Creek and Fisher River watersheds. Potential adverse effects from surface disturbances (increased runoff and erosion, and increased sediment loading in Libby Creek or the Fisher River) would be reduced through implementation of runoff and sediment control practices prior to and during facility construction.

Mining would occur below and adjacent to Rock Lake and beneath St. Paul Lake, both located in the Cabinet Mountains Wilderness. The proposed avoidance distance for Rock Lake should be sufficient to prevent drainage of or effects on lake waters.

No surface water withdrawals from or direct discharges to receiving streams are proposed. Seepage from the tailings impoundment and excess water discharge to the land application disposal areas would eventually reach surface waters. As a result of Noranda's discharges, streamflow in area streams would increase. During operations, the maximum projected increase would be greatest under low flow conditions, ranging from a seven percent increase in streamflow in upper Libby Creek to a five percent increase in Libby Creek below Hoodoo Creek. After operations, the projected increase during low flow ranges from two percent to seven percent below Little Cherry Creek and one percent to five percent below Hoodoo Creek. Under average flow conditions, the projected increases would be less than one percent at the same locations during and following operations.

Streamflow changes under Alternatives 2 and 3 would be the same as those described for Alternative 1. Noranda would modify the design of the diversions associated with the impoundment under these alternatives, which would reduce the amount of sediment reaching Libby Creek.

The three transmission line alternatives (4, 5 and 6) would incorporate use of a helicopter for line stringing, avoiding impacts that would be caused by bulldozer stringing equipment. Using a helicopter would prevent sedimentation impacts at the bulldozer crossings of the Fisher River, Howard Creek, and Libby Creek, where existing bridges would provide access for other construction activities.

Under Alternative 7, no surface disturbance and no increased erosion would occur. Stream flow would be affected by continued flow from the Libby Creek adit until it is reclaimed in accordance with the DSL permit.

ALTERNATIVE 1

Runoff and Sedimentation

Mine facilities construction and operation. Noranda would control runoff and sedimentation using runoff and sediment control practices for timber removal, road construction and maintenance, and general construction (Appendix G). Implementing these practices properly would minimize the amount of sediment reaching area streams.

These practices also would include snow removal and disposal to ensure proper functioning of runoff and sediment control systems. Snow and ice

removed from the surface facilities would be deposited in the Ramsey Creek land application disposal areas to prevent uncontrolled release of sediment (possibly containing heavy metals) trapped in snow during removal procedures.

Noranda does not intend to provide erosion protection for the natural stream channel downstream of the Little Cherry Creek diversion channel, assuming the existing vegetation would protect the channel. It is unlikely, however, that the existing vegetation would provide adequate erosion protection. If it is insufficient, gullying of the channel would occur, and additional sediment would be delivered to Libby Creek.

The downstream face of the tailings dam would form a long (1,140 feet), 3 to 1 slope. Some erosion of the dam face would occur during operations. Eroded sediment would be captured behind the seepage collection dam located downstream of the impoundment. The seepage collection pond may require occasional dredging to remove accumulated sediment. During reclamation, Noranda would install benches on the tailings dam face on 200 to 400-foot intervals. Prior to establishment of vegetation following reclamation, topsoil used in reclamation would be removed by wind and water erosion. Erosion rates on the face of the Little Cherry Creek diversion dam and the two saddle dams would be less than on the main starter dam and embankment because of their shorter slope lengths. Much of the sediment eroded from the impoundment face would be deposited at the base of the impoundment slope. Some sediment may be transported to the seepage collection pond. To mitigate this potential problem, Noranda would riprap the tailings dam crest and upper portions of the dam face. The lower portions of the dam face would still be susceptible to rill erosion and gullying. If topsoil erosion proves problematic, Noranda would stabilize the topsoil through the use of mulches, tackifiers or other methods. Noranda would stabilize and revegetate, as necessary, all rills and gullies.

The tailings impoundment would be situated to maximize tailings storage capacity, and to minimize upstream watershed area drainage along the length of the permanent diversion channel. The permanent diversion system, consisting of a dam at the upstream end of the impoundment and the diversion channel, would route surface water around the impoundment and into Libby Creek. In the design of the diversion, several types of storm events were considered. The diversion channel would be designed to convey the maximum probable flood runoff occurring during a 6-hour, localized storm. Because of the expected flow velocities, the diversion channel would be riprapped to minimize channel erosion. The long-term stability of the riprap would be evaluated at the completion of operation to ensure adequate permanent erosion control. The diversion channel would be inspected regularly during its 16-year operational life.

At the end of operations, the top of the impoundment would be graded toward the northwest at a slope between 0.5 percent and 1 percent. Runoff would be collected in a permanent diversion ditch at the upper end of the impoundment and diverted into Bear Creek. The diversion ditch would direct flow toward a saddle along the divide between the Little Cherry Creek and Bear Creek watersheds. From this point, runoff would be discharged as uncontrolled flow down the hillslope and into Bear Creek. The flow may result in gullying of the hillslope and transport of sediment into Bear Creek.

Some sediment would reach Libby Creek. The amount of sediment reaching Libby Creek would depend on weather conditions during project construction (primarily amount and intensity of precipitation), on the efficacy of Noranda's proposed runoff and sediment control practices, and on the proper operation and maintenance of the runoff and sediment control system.

Transmission line stream crossings. All alternative routes cross the Fisher River and its floodplain (Table 4-7). Channel movement would affect the

Table 4-7. Perennial stream crossings by construction vehicles along transmission line alignment alternatives.

Stream	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Fisher River	●	∅	∅	∅
Brulee Creek	⊗	⊗	⊗	⊗
Schrieber Creek	⊗	⊗	⊗	∅
Howard Creek	●	∅	∅	∅
Libby Creek	●	∅	∅	∅
Ramsey Creek	●	∅	∅	∅
Miller Creek	●×	×	⊗	⊗

Source: Noranda Minerals Corp. 1989c.
⊗ = stream not crossed by alternative
∅ = stream would be crossed by construction equipment using existing bridge and road
× = reconstruction would be necessary to replace washed-out bridge
● = stream would be crossed by crawler tractor during line stringing operations

stability of structures located too near the river, although Noranda and the agencies would exercise caution when siting structures near the river. Still, construction of the transmission line can be expected to result in minor increased sediment production during construction and revegetation periods.

All alternatives would cross Libby Creek and Howard Creek north of Howard Lake. Existing bridges are expected to provide crossings for most construction vehicles. The notable exception under this alternative would be the crawler tractor proposed to pull the sock line during stringing of the line. Use of existing bridges would avoid most sediment production.

All alternatives cross Ramsey Creek at a location where there is no existing bridge. Temporary stream crossing during construction, such as during line stringing operations, would result in sediment entering the stream. Noranda would work with the agencies to determine the best crossing location and method to minimize increased sediment production. Joint use of the temporary bridge across Ramsey Creek, proposed for hauling waste rock from the Libby Creek adit site, would reduce potential effects from transmission line construction at this crossing.

Alternative 1 would cross five perennial streams, including the Fisher River. During construction, small amounts of sediment would be released into these streams. Noranda has committed to use appropriate stream crossing methods as determined by a field review with the agencies if this alternative were selected (see *Environmental Specifications for the 230-kV Transmission Line*, Appendix F).

In the vicinity of U.S. 2 and the Fisher River, two or three transmission line structures would be located in a 200-foot wide strip of land between the Fisher River and the Champion haul road. About 1,400 feet of new road on 60 percent slopes above the river would be needed to provide access to the structures. These roads would have a moderate potential to introduce sediment to the river. Sediment levels also would increase for a short time if line stringing activities require crossing the river.

As the route turns up the Miller Creek drainage, one span would be located within 200 feet of Miller Creek. The main Miller Creek road is located

between the proposed transmission line and the creek Few new disturbances would be expected and little sediment would be expected to reach Miller Creek in this area during construction. Minor sedimentation would occur during stringing across Howard, Libby, and Ramsey creeks.

Construction and operation of the Ramsey Creek substation would not affect water quality, due to substation design and drainage controls proposed at the mine site. Sedlak Creek would be rerouted around the new substation site at Sedlak Park. Construction activities may introduce small amounts of sediment into the Fisher River from this intermittent stream.

Streamflow

The section *Water Use and Management* in Chapter 2 describes Noranda's estimated water balance and contingency plans to manage too little or too much water. Noranda's project water requirements primarily would be provided by using mine and adit water from underground workings, recycling overflow from the tailings thickener, and returning tailings water from the impoundment. Additional water would be needed for the first 10 years of operation. Noranda has identified several potential sources of additional water, such as increasing adit inflows, increasing water storage in the tailings impoundment, and drilling water supply wells. If these sources are inadequate to meet necessary water requirements, Noranda would use surface water from either Libby or Ramsey creeks. Prior to withdrawal of surface water, Noranda would need to apply for and obtain necessary water rights and permits.

Noranda holds temporary permits to appropriate water in Ramsey, Poorman, and Little Cherry creeks. These water withdrawal permits specify that withdrawn water be used for activities associated with the Libby Creek evaluation adit and with engineering planning (drilling, dust suppression, etc.). They are not transferable to operational mill use.

Since Noranda does not anticipate using surface water, timing and amounts of withdrawals have not been specified. The tailings impoundment has considerable water storage capacity. Water could be withdrawn from streams during high spring flows with little adverse effects on streamflow, water quality or aquatic life. Withdrawals during low flows may reduce streamflows and affect water quality and aquatic life.

Construction phase. During adit construction and initial mine development, adit and mine water would be pumped to the surface and discharged to ground water in lower Ramsey Creek using the land application disposal areas. The Libby Creek adit percolation pond/land application disposal area also may be used if excess water quality is equal to or better than ambient water quality. The excess water disposal system is designed to have a capacity to store or discharge up to 2,000 gpm of excess water.

The construction phase impact assessment is based on estimated adit inflows of 542 gpm and estimated mine inflows of 11 gpm. These inflows would enter the underground workings and require disposal prior to mill operation. (The actual rate of inflow would vary because much of the water would be produced as short-term, higher-rate inflows when saturated fractures are first encountered during development). Adit construction and initial mine development would occur for a three-year period prior to production. Mine inflows would occur after completing the Libby Creek adit. Any resulting increased streamflow in Libby Creek or Ramsey Creek would be short term due to the relatively short time when excess water would be discharged to the land application disposal areas.

Operational phase. Once operations begin, the adits and mine inflows would be used in the mill. Beginning in Year 10 of operations, Noranda expects excess water that would require disposal. Adit inflows would be segregated and discharged to the land application disposal areas. Disposed volumes

would peak at an estimated 183 gpm in Year 16 (Table 2-5).

A longer-term increase in streamflow in Libby Creek would result from discharge of excess mine and adit water, and tailings impoundment seepage. Seepage from the tailings impoundment would enter shallow ground water systems discharging to Libby Creek. The seepage rate would increase from 50 gpm during the first year of operations, to an estimated 475 gpm when the impoundment reaches its maximum volume in Year 16 of operations.

Noranda proposes to intercept enough seepage to ensure that water quality standards are maintained in all potentially affected creeks (Ramsey Creek, Poorman Creek, Little Cherry Creek and Libby Creek). Based on the estimated water balance (see Chapter 2) and estimated tailings water quality (see Chapter 6), Noranda anticipates intercepting 46 gpm of seepage water in Year 1 of operations and 378 gpm in Year 16. Noranda estimates that the water collected by the relief wells would be 70 percent tailings seepage and 30 percent ground water in Year 1 of operations, and 97 percent seepage and 3 percent ground water in Year 16 (Noranda Minerals Corp., June 17, 1991). Total ground water discharge in Year 16 is estimated in Noranda's water balance at 280 gpm (97 gpm of tailings seepage and 183 gpm of adit inflows). An additional 6 gpm is estimate to reach Libby Creek from dam seepages.

Streamflow increases were projected at several locations (Table 4-8). The projected increases assume the 280 gpm ground water discharge and the 6 gpm seepage from the "saddle" dam on the south side of the impoundment (see Figure 2-11 in Chapter 2) would reach Libby Creek simultaneously. The projected increase would be greatest under low flow conditions and would range from 7 percent on Libby Creek below Little Cherry Creek to 4.5 percent on Libby Creek below Hoodoo Creek. The projected low flow increase is relatively small, and would not affect stream channel stability.

Under average flow conditions, the projected increases would be less than one percent and would not affect stream channel stability. If the tailings impoundment seepage or excess water volumes are greater than (or less than) the amounts used to make

Table 4-8. Estimated changes in Libby Creek streamflow.

Location	Low flow (7-day, 10-year) Existing (cfs)	Projected (cfs)	Increase (%)	Average annual flow Existing (cfs)	Projected (cfs)	Increase (%)
During operations (Year 16)						
Libby Creek below Little Cherry Creek	8.7	9.3	6.9	122	122.6	0.5
Libby Creek below Hoodoo Creek	13.4	14.0	4.5	188	188.6	0.3
Post operations (Steady state conditions)						
Libby Creek below Little Cherry Creek						
(@ 75 gpm)	8.7	8.9	2.3	—	—	—
(@ 290 gpm)	8.7	9.3	6.9	—	—	—
Libby Creek below Hoodoo Creek						
(@ 75 gpm)	13.4	13.6	1.5	—	—	—
(@ 290 gpm)	13.4	14.0	4.5	—	—	—

Source: IMS Inc. 1991.

the projection, streamflow increase would change correspondingly.

As shown in Figure 2-13, mine water provides the primary source of water for the proposed Montanore Project. Much of this water would ultimately discharge to the tailings pond, and to the land application disposal area. Mine and adit discharges would then enter shallow ground water systems which discharge to Libby Creek. A portion of the tailings pond seepage may also originate as precipitation in the tailings pond area. Under ambient conditions, much of the precipitation contributes to streamflow during snowmelt or storm events. As tailings pond seepage, this precipitation also will contribute to low flow conditions.

Ground water in the bedrock system flows along fracture trends toward topographic lows, discharging to high mountain lakes, springs, streams, and unconsolidated valley fill deposits. Ground water in the mine area probably discharges in the Libby Creek, the Rock Creek, and the Bull River watersheds. Mine water inflow would result from the dewatering of ground water storage and from the interception of ground water currently discharging to the Libby Creek, Rock Creek or Bull River watersheds.

The proportion of the ground water system currently discharging to Libby Creek that would be affected by the mine is unknown. Since some water is already discharging to Libby Creek, it would not be a new discharge, and would not increase streamflow. However, mine water inflow derived from ground water storage and from ground water systems currently discharging to Rock Creek and Bull River would result in water from new sources being discharged to Libby Creek. If inflow estimates are correct, the analysis of increased stream flow presents the upper bound for possible stream flow increase because it includes an unknown amount of ground water already discharging to Libby Creek. The actual increase in Libby Creek streamflow would be an undetermined amount less. The purpose of the streamflow analysis is to assess the potential effect of the mine water discharges on streamflow in Libby Creek. The analysis shows that tailings pond seepage and mine and adit water discharges would not increase streamflow in Libby Creek significantly.

Post-operational phase. At the end of operations, saturated water levels in the tailings impoundment would drop until steady state conditions are achieved. Noranda estimates that reaching steady state conditions might take between 20 and 40 years (Morrison-Knudsen Engineers, Inc., 1990d). Seepage through the tailings dam and the bottom of the impoundment would also decrease as the saturated water levels drop. Lower portions of the tailings mass would remain saturated after new steady state conditions are established. Under these conditions, total seepage (seepage through the dam and the bottom of the impoundment) is expected to be 70 gpm to 290 gpm (Morrison-Knudsen Engineers, Inc., 1990d).

Under steady state conditions, the projected post-operational seepage (70 gpm to 290 gpm) would originate as precipitation. It would not be new water being discharged to Libby Creek. Prior to operations, it is likely this water left the basin as snow melt or storm runoff. The tailings impoundment would regulate seepage so that the discharge would contribute to low flow as well as high flow. The annual average flow would not be affected by operations. Under low flow conditions, the projected flow increases in Libby Creek below Little Cherry Creek and below Hoodoo Creek would range from about two percent to seven percent.

Noranda has proposed to divert Little Cherry Creek around the tailings impoundment. Snow melt and storm runoff from the upper portion of the Little Cherry Creek watershed would be routed permanently into an unnamed tributary of Libby Creek. Streamflow in Little Cherry Creek below the impoundment would be reduced significantly because the watershed area contributing to runoff would be less.

Noranda also plans to intercept tailings impoundment seepage and ground water in a well collection system below the impoundment. Depending upon the location of the relief wells and whether pumping of the relief wells would be required, shallow ground water levels may be lowered and ground water discharge to and baseflow in lower Little Cherry Creek may be reduced. Springs and seeps around the impoundment may not be affected by a passive relief well system. If ground water levels are sufficiently lowered, lower Little Cherry Creek would cease to be a perennial stream. The loss in baseflow in the stream may be partially or completely offset by seepage from the seepage collection pond, downstream of the impoundment, and use of water from the pressure relief/seepage interception system as part of the wetlands mitigation program. In predicting water quality and aquatic life impacts, it was assumed that Little Cherry Creek would no longer be a perennial stream.

The post-operational streamflow analysis assumes there would be no post-mining discharge of mine or adit water. Depending on mine and adit inflows, discharge may occur from the Libby Creek adit (see *Ground Water Hydrology* section). Mine inflows and discharge would increase into the mine as grout fails, or may decrease as water stored in joints and fractures is depleted.

Floodplains

All transmission line routes cross areas designated by the Montana Board of Natural Resources and Conservation and mapped by the U.S. Department of Housing and Urban Development (1980) as 100-year floodplains. Within the study area, floodplains have been mapped along the Fisher River, Miller Creek, Libby Creek, and Ramsey Creek. Table 4-9 indicates the estimated number of structures (transmission line poles) within the designated 100-year floodplain. Channel movement of the Fisher River caused by flooding could affect structure stability and would require proper foundation design and structure location to minimize possible effects. Noranda would be required to obtain a permit from the Lincoln County Disaster and Emergency Services coordinator to construct structures within any designated floodplain. The proposed structures would minimize the potential for obstructing streams and rivers and would be located within the floodplain with these considerations in mind.

The plant site is near a designated 100-year floodplain in upper Ramsey Creek. As with the transmission line, Noranda must show in the final design that the proposed plant design minimizes the potential for obstructing Ramsey Creek if the floodplain would be affected by the plant.

Wilderness Lakes

There are several lakes located above or adjacent to the underground mine area, including Rock Lake, St. Paul Lake, and Libby Lakes. Rock Lake is situated along the Rock Lake Fault, and may be hydraulically connected to the fault. In addition, the lake is adjacent to the ore outcrop at the southern end of the deposit. Mining adjacent to Rock Lake, or within the fault zone in this area, could intercept shallow ground water and affect the lake level. Interception may directly drain surface water from the lake or affect ground water systems currently discharging to the lake. As a result, water levels in the lake and

Table 4-9. Estimated number of structures on designated 100-year floodplains.

Alternative	Structures within 100-year flood boundaries
1	3
4	3
5	3
6	6

Source: U.S. Department of Housing and Urban Development. 1980. National Flood Insurance Program, Flood Insurance Rate Map. Lincoln County, Montana (unincorporated areas).

surface water outflow from the lake might be reduced.

To prevent these effects, Noranda would maintain an initial minimum mining distance of 500 feet horizontally and vertically from the lake (Figure 2-8). This distance would be maintained unless underground studies indicate that mining can occur closer to, or would have to be farther from, the lake without adverse effects. Noranda also would maintain an initial minimum mining distance of 100 feet from the Rock Lake Fault to isolate the mine workings from water stored in the fault and to avoid adversely affecting water levels in Rock Lake should the Rock Lake fault act as a hydraulic connection between mine workings and the lake. The extent of the fractured zone and stored water related to the Rock Lake Fault has not been defined. Hydrologic studies would be conducted to determine if a narrower avoidance distance could be achieved, or if a wider avoidance zone would be needed. These studies would include drilling into the fault zone to determine hydraulic conductivities and transmissivities of the fault and transition zones, the fault and transition zone widths, and water pressures in the fault and transition zones.

Noranda's proposed monitoring program would detect and evaluate changes in lake water levels, and would allow the agencies and Noranda to take requisite actions. The avoidance distances, monitoring plan, and hydrologic studies should be sufficient to prevent and detect effects to Rock Lake and to prevent significant inflows from the Rock Lake Fault (see *Ground Water Hydrology* section).

St. Paul Lake is also situated along the Rock Lake Fault. It is located on the northwest edge of the ore deposit, where the mining zone is over 3,000 feet below ground surface. Because of the depth of the mining zone, it is unlikely that mining would result in direct drainage of the lake or intercept ground water systems recharging the lake. If mining were to intercept the Rock Lake Fault, however, water levels in the lake could be affected.

Libby Lakes are located along the eastern margin of the mine area. The ore body does not outcrop near Libby Lakes and no major faults are associated with the lakes. (The lakes lie west of the Libby Lake Fault trace.) The mining zone is located over 3,000 feet below the ground surface. It is unlikely that mining would affect water levels in these lakes.

ALTERNATIVES 2 AND 3

The agencies' modifications to Noranda's proposal which would reduce sedimentation to Libby Creek include—

- designing a channel from the outlet of Little Cherry Creek diversion channel to Libby Creek; and
- designing a riprapped channel from the reclaimed impoundment to Bear Creek.

These design changes, when approved by the agencies and implemented, would reduce sediments reaching Libby Creek. Other impacts associated with erosion and sedimentation, streamflow, floodplains, and wilderness lakes described under Alternative 1 would occur.

One option under Alternative 3 would be the use of additional LAD areas in the tailings impoundment area. The agencies do not expected significantly increased erosion and sedimentation from these areas if spray irrigation is used.

IMPACTS COMMON TO ALTERNATIVES 4, 5 AND 6

A helicopter would be used for line stringing, avoiding impacts that would be caused by bulldozer stringing equipment. Using a helicopter would prevent sedimentation impacts at the bulldozer crossings of the Fisher River, Howard Creek, and Libby Creek, where existing bridges would provide access for other construction activities. Crossings for pole placement activities would still be required on Ramsey Creek. The crossing location and method would be determined by the agencies following a field investigation.

Portions of Alternatives 4, 5, and 6 share common segments. Impacts on these common segments are described in this section and the mitigation measures discussed would apply to all alternatives. On the segment common to all alternatives in the vicinity of U.S. 2 and the Fisher River, three transmission line structures would be located in a 200-foot wide strip of land between the Fisher River and the Champion International Corporation's haul road. About 1,200 feet of new road on slopes up to 60 percent would be needed to provide access to the structures. An old landslide south of where Alternatives 4 and 5 diverge to cross the Fisher River would be crossed by the access road. This road would have a moderate to high potential to introduce sediment to the river. Potential for sediment to reach the river from construction of these roads could be reduced to a low level by moving the alignment 200 to 300 feet to the east to parallel an existing road and by applying Best Management Practices proposed by the agencies and Noranda. The DNRC and the KNF would recommend this change to the Board of Natural Resources and Conservation and would review final design of the line to minimize problems due to location through this area. Maintaining a vegetative buffer between construction disturbance and the stream would reduce sedimentation.

Appendix H describes additional areas along the various alternatives where increased potential for soil erosion and sediment production is present. Additional review by the DNRC and the KNF would be required during final tower and road location design to ensure that the erosion control measures used during construction and reclamation measures to be used following construction would be the best available for the situation.

As shown in Table 4-7, all alternatives would cross Libby, Howard, and Ramsey creeks. Existing bridges would provide crossings for construction vehicles. Use of existing bridges would avoid much production of sediment that otherwise would result from construction traffic crossing the streams.

Construction and operation of the Ramsey Creek substation would have only small effects on sediment yield, due to proposed drainage controls. Sedlak Creek would be rerouted around the new substation site at Sedlak Park. Construction activities in Sedlak Creek might introduce sediment into Sedlak Creek and the Fisher River. Appendix H contains measures DNRC identified to minimize sedimentation impacts at Sedlak Park. These measures would be incorporated into DNRC's Environmental Specifications.

The DNRC and the KNF would recommend that project approvals include the provision for sufficient time for review and approval of final tower and access road locations prior to start of construction. The DNRC will ask the Board for the authority to work with Noranda to apply mitigation measures to match site-specific conditions based on this review. This authority would include the identification of site-specific mitigation measures where required to ensure that the measures used at individual sites are the most appropriate for the situation.

DNRC's Environmental Specifications also would be revised to incorporate by reference the erosion control measures contained in the Soil and Water Conservation Handbook (USFS, 1988) and Revised Hydraulic Guide (KNF, 1985).

ALTERNATIVE 4

As the route turns up the Miller Creek drainage, one span would be located within 200 feet of Miller Creek. The main Miller Creek road is located between the proposed transmission line and the creek. Few new disturbances would be expected and little sediment would be expected to reach Miller Creek in this area during construction. However, a bridge or other stream crossing method would be required near the confluence of Miller Creek and the South Fork of Miller Creek to replace a washed-out bridge. Sediment might enter the stream during construction, though the effects would be avoided to the extent possible by following bridge construction

standards and procedures routinely used by KNF. Existing bridges would provide access for construction activities, minimizing sedimentation at crossings of the Fisher River, Howard Creek, and Libby Creek (Table 4-7). As with Alternative 1, two or three structures would be located in the flood plain of the Fisher River.

ALTERNATIVE 5

The hydrology impacts of the North Miller Creek transmission line route (Alternative 5) and the measures required to mitigate them would be the same as for Alternative 4 (Miller Creek route) where the routes are common to both alternatives.

Where this alternative diverges from Alternative 4, the line would follow an unnamed intermittent tributary drainage of Miller Creek for about 1.5 miles. Adjustments in the centerline alignment have placed the line above an existing road and farther from the stream, reducing potential for impacts due to line construction. Access roads would be necessary along this unnamed tributary for about 1/4 mile (Figure 4-1). Due to the steepness of this drainage, the disturbance of soils during access road construction may introduce sediment into the tributary unless an adequate buffer of undisturbed vegetation remains between the creek and new road. Prompt revegetation also would reduce the potential for sedimentation following construction. These measures are provided for through the Best Management Practices proposed by the agencies and Noranda. Adoption of Best Management Practices would be part of the Board's approval for any of the alternatives. In addition, the KNF, the DNRC, and Noranda would participate in a field inspection to review sediment control measures after the road location is surveyed but before construction takes place. This would ensure that measures are the best available for the situation.

Existing bridges would provide access for construction activities and no new stream crossings would be required on Howard, Libby, or Ramsey creeks.

ALTERNATIVE 6

The centerline in a portion of Alternative 6 would coincide with Alternatives 4 and 5, and impacts and the mitigation measures would be the same (see Appendix H). The Fisher River shows signs of channel movement in the vicinity of the proposed crossing by Alternative 6 south of the river's confluence with Brulee Creek. The Fisher River has been channelized to prevent damage to one nearby residence. However, the active nature of the river in this area makes this crossing less desirable than the location crossed by Alternatives 4 and 5. Increasing the structure height and span length or other design alternatives would be required to help ensure that future channel movements do not pose a hazard to transmission line structures near the river.

Alternative 6 would cross Schrieber Creek after crossing the Fisher River. Construction access to structures would be available without any additional stream crossings. Existing bridges would be used to provide access for construction of the line, and no new stream crossings would be required on Howard, Libby, and Ramsey creeks.

CUMULATIVE IMPACTS

Cumulative impacts for all alternatives would be similar. ASARCO's proposed Rock Creek project in the Rock Creek watershed would not affect the quantity or quality of water in Libby Creek. No cumulative effects are anticipated on Libby Creek from the two mine operations. An unknown minor amount of the water which would enter the mine workings may currently discharge to the Rock Creek or Bull River drainage. Streamflow in these drainages may be reduced by the Montanore Project.

The timber sales currently projected in the Libby Creek or Fisher River watersheds potentially may increase peak flows. The amount of these peak flow increases would depend on timing and site specific

information that is unknown at this time. Additional sediment might also reach these watersheds from logging and road construction activities. The KNF requires the implementation of Best Management Practices during logging operations. If these practices are properly implemented and maintained, then additional sediment transport into the drainages would be minimized. Proposed highway construction also may increase sediment reaching streams potentially affected by the Montanore Project.

RESOURCE COMMITMENTS

Increased erosion and sedimentation would occur as a result of the Montanore Project, with greatest increases during the construction period. The amount of sediment reaching area streams would depend on weather conditions during project construction (primarily amount and intensity of precipitation), on the efficacy of Noranda's proposed runoff and sediment control practices and the agencies' mitigations for Alternatives 2 through 6, and on the proper operation and maintenance of the runoff and sediment control system. The sediment could be deposited in Libby Creek, the Fisher River or in their tributaries, or be transported downstream to the Kootenai River. Any increased sedimentation would be an irreversible commitment of resources. Most of this increase would be of short duration and would not affect the long-term productivity of the land or streams.

As discussed under *Cumulative Impacts*, streamflow in the Bull River or Rock Creek drainages may be reduced by mine inflows. After operations, mine inflows may stay within the abandoned mine, or discharge from the Libby Creek adit or non-point sources. Streamflow in Libby Creek may be slightly increased. The Montanore Project would result in a irreversible commitment of these resources if these changes occur.

ALTERNATIVE 7

Projected increases in sediments and streamflow would not occur under Alternative 7. The Libby Creek adit would be reclaimed in accordance with the exploration permit issued by the DSL.

SURFACE WATER QUALITY

SUMMARY

Under Alternatives 1 and 2, discharges would alter the water quality in Ramsey, Poorman and Libby creeks by increasing the concentrations of total dissolved solids, nutrients and metals. The greatest effect would occur under low flow conditions when the dilution capacity of receiving streams would be at a minimum. Assuming no plant uptake of nitrates, total nitrogen (nitrates, nitrites, and ammonia) concentration in Ramsey Creek is projected to exceed 1 mg/L, a concentration expected to produce undesirable aquatic life in surface waters, at least 62 percent of the time. Plant uptake of nitrogen would reduce the amount of nitrogen reaching area streams. Effects from discharges during operations would be less than those projected during the construction phase. Discharge of excess tailings water during a three-year post-operational period is projected to violate state surface water quality standards for manganese at low flow conditions. Nitrogen concentrations also could exceed 1 mg/L in Poorman and Ramsey creeks during the post-operational period.

Under Alternative 1, 2, and 3, Noranda would implement a monitoring program designed to evaluate compliance with applicable regulatory standards. The monitoring program is designed to develop information on water management, particularly on the quantity and quality of tailings impoundment

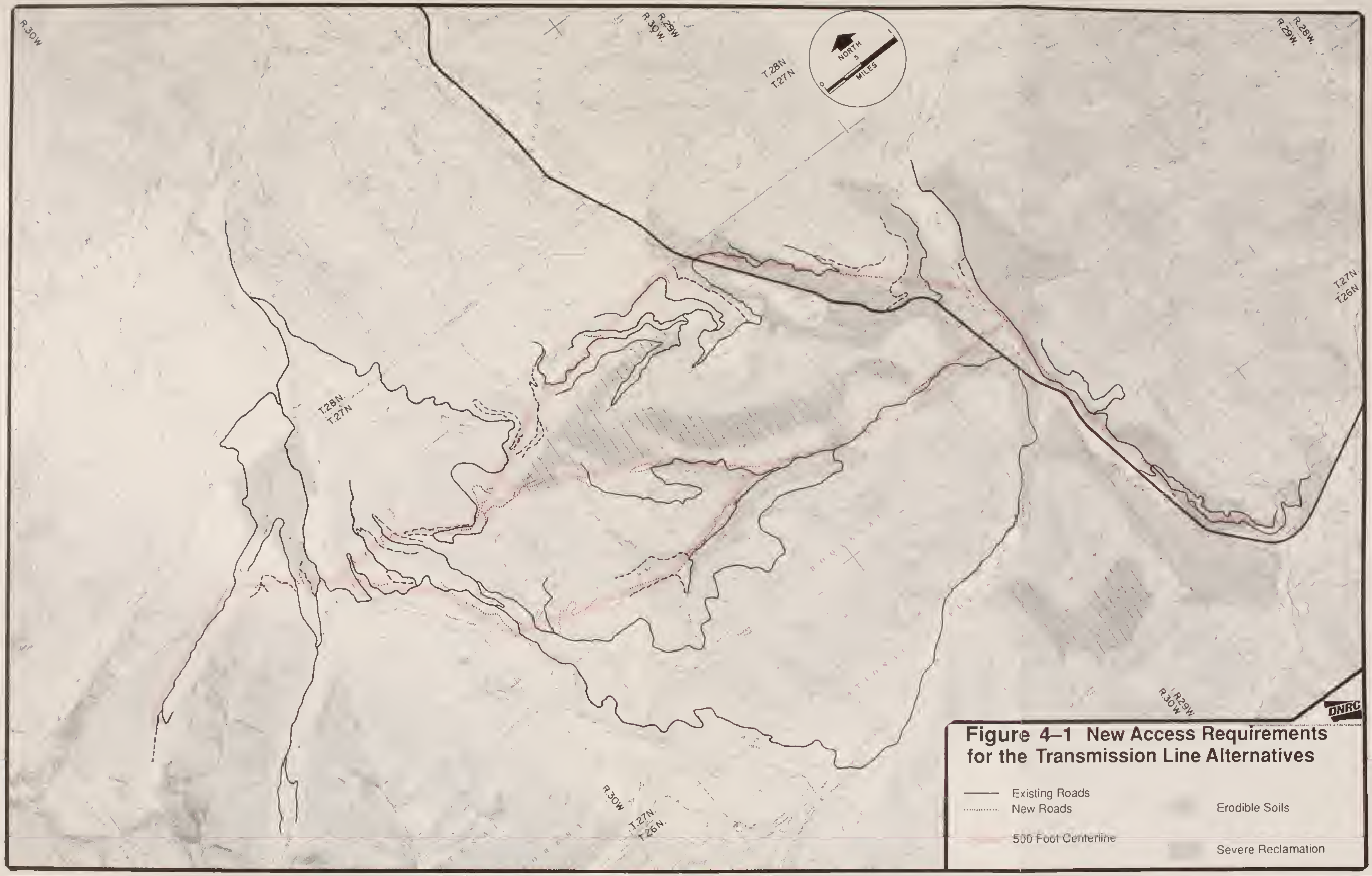


Figure 4–1 New Access Requirements for the Transmission Line Alternatives

seepage, and adit and mine inflows. A monitoring program has been proposed by Noranda as part of Alternative 1 and revised by the agencies as part of Alternatives 2 and 3.

The agencies expect that the mine would eventually discharge water following operations. Adverse water quality effects from acid drainage are not expected. If discharges occur, Noranda would plug the adits if water quality standards cannot be met. Under Alternatives 2 and 3, treatment of mine discharge or tailings water may be necessary in perpetuity if water quality standards would be violated.

Under Alternative 3, Noranda would be required to design and seek agency approval of a detailed water management/treatment plan to ensure surface water quality standards are maintained for all phases of the project. Lining of the impoundment, Option 3A, would essentially eliminate tailings impoundment seepage. All excess water would be treated by mechanical treatment. Full lining and treatment of all excess water would cost about $28 million over the project life. Treatment of excess high nitrate water during both a three-year construction period and a three-year post-operational period (Option 3B) would cost about $7 million. Costs for land application treatment (Option 3C) have not been estimated. Projected concentrations for metals under all options would be below ambient concentrations.

Projected concentrations for total nitrogen would be below applicable standards under Alternatives 3A and 3B. Depending on the actual concentrations of ammonia and nitrates/nitrites in excess water, total nitrogen concentrations under Alternative 3C may exceed concentrations designed to protect aquatic life. Noranda would institute additional monitoring in Year 1 of construction to determine actual nitrate and ammonia concentrations in excess water. Additional ground and surface water monitoring also would be conducted under Alternative 3C. An authorization allowing a change in ambient water quality from the Montana Department of Health and Environmental Sciences prior to project initiation would be necessary under all options.

Construction of the transmission line (Alternatives 1, 4, 5, or 6) would have little effect on surface water quality. Under Alternative 7, changes to water quality would not occur. The Libby Creek adit would be reclaimed in accordance with the exploration permit issued by the DSL.

CHANGES IN AMBIENT WATER QUALITY AND NON-DEGRADATION REGULATIONS

In Noranda's project water balance, excess water discharges would occur during three time periods—during a three-year construction period prior to mill operation, in Years 10 through 16 of operations, and after mining ceases. Tailings seepage would occur after mill operations begin and would continue in perpetuity. The excess water generally would have higher concentrations of most parameters than in ambient stream water (Table 4-10 and Tables 4-11 and 4-12). As a result, mine and adit water discharged to the land application disposal area and seepage from the tailings impoundment not collected by the seepage interception system would enter ground water and eventually change the surface water quality in nearby streams.

Changes in ground or surface water quality above ambient concentrations is prohibited unless the Montana Board of Health and Environmental Sciences determines that the changes are justified as a result of necessary social or economic development, and that the changes would not preclude present or anticipated uses of the water resources. The Board of Health and Environmental Sciences, however,

Table 4-10. Estimated mine, adit, and tailings water quality.

Parameter	Tailings seepage	Construction adit water Ramsey Creek	Construction adit water Libby Creek	Post-construction adit water	Mine water
	(mg/L)				
Total dissolved solids	174	222	222	222	189
Total hardness	43	70	70	70	83
Total alkalinity	172	107	107	107	80
Ammonia (high range)	26.9	53.7	26.9	0.69	26.9
Ammonia (low range)	15.7	15.7	15.7	0.69	15.7
Nitrate/nitrite (high range)	40.7	81.4	40.7	1.04	40.7
Nitrate/nitrite (low range)	23.5	23.5	23.5	1.04	23.5
Aluminum	0.1	<0.3	<0.3	<0.3	<0.1
Arsenic	<0.001	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001	<0.001	<0.001	<0.001	<0.001
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	<0.013	<0.015	<0.015	<0.015	0.075
Iron	<0.04	<0.16	<0.16	<0.16	<0.05
Lead	<0.0015	<0.01	<0.01	<0.01	<0.01
Manganese	0.45	<0.04	<0.04	<0.04	0.42
Mercury	<0.0010	<0.0002	<0.0002	<0.0002	<0.001
Silver	<0.004	<0.001	<0.001	<0.001	<0.005
Zinc	<0.02	<0.03	<0.03	<0.03	0.02

Source: see Chapter 6 for discussion of expected water quality. A discussion of "high range" and "low range" of nitrate and ammonia concentrations is provided in a subsequent section.

Table 4-11. Ambient surface water quality during low flow conditions at two monitoring stations.

Parameter	LB 2000 Oct. 1991	LB 2000 Sept. 1990	LB 2000 Sept. 1988	PM 1000 Oct. 1991	PM 1000 Aug. 1989	PM 1000 Sept. 1988
	(mg/L)					
Flow (cfs)	8.81	13.15	5.8	1.63	2.2	0.7
TDS	40	17C	41	15	32BCR	29
Hardness	34.7	26	26	14	<12	10
Alkalinity	34	28C	34	17	16	20
Ammonia	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate/nitrite[†]	0.73	0.47	0.03B	0.04	0.05B	0.04B
Sulfate	3	2	2	2	2	2
Aluminum	<0.1CZ	<0.1	<0.1	<0.1CZ	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001CZ	<0.0001	0.0007ABCZ	<0.0001CZ	<0.0005BCZ	<0.0019ABCZ
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.001	0.001CZ	<0.001	0.001	0.001	0.002
Iron	<0.05	<0.05CZ	<0.05	<0.05	<0.05	<0.05
Lead	<0.001	0.002CZ	<0.001	<0.001	<0.001	<0.001
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	<0.0002AZ	0.0032AZ	0.0003	<0.0002AZ	<0.0002	0.0004
Zinc	<0.02	0.04CRZ	<0.02	<0.02	<0.02	<0.02

Sources: Chen-Northern, Inc. 1989; 1990; 1991a; 1992. Metals concentrations are total recoverable.
[†]Nitrate concentrations at LB 2000 in 1990 and 1991 were affected by Libby Creek adit discharges.

Table 4-12. Ambient surface water quality during low flow conditions at the Ramsey Creek station.

Parameter	RA 550 Oct. 1991	RA 600 Sept. 1990	RA 600 Sept. 1989	RA 600 Sept. 1988
	(mg/L)			
Flow (cfs)	1.21	5.29	4	1.4
TDS	14	<1C	12B	15
Hardness	5	<7	<7	<6
Alkalinity	6	6C	7	8
Ammonia	0.23	0.06	<0.05	<0.05
Nitrate/nitrite	0.06	0.07	0.06C	0.07B
Sulfate	6	1	1BC	2
Aluminum	0.1CZ	<0.1	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001CZ	<0.0001	<0.0001	0.0010ABCZ
Chromium	<0.02	<0.02	<0.02	<0.02
Copper	<0.001	<0.001CZ	0.006BC	0.002
Iron	<0.05	<0.05CZ	<0.05	<0.05
Lead	<0.002	0.002CZ	<0.001	<0.001
Manganese	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002
Silver	<0.0002AZ	0.0001AZ	<0.0002AZ	<0.0002
Zinc	<0.02	0.01CRZ	<0.02CZ	<0.02

Sources: Chen-Northern, Inc. 1989; 1990; 1991a; 1992. Metals concentrations are total recoverable.

Notes:
A–blind field standard outside advisory range
B–bottle blank equal to or above detection limit
C–cross-contamination blank equal to or above detection limit
R–field duplicates outside expected range
Z–value not useable for statistics

cannot approve water quality changes beyond the water quality standards established by regulation (Montana Department of Health and Environmental Sciences, 1990, letter to individuals who submitted written comments on Noranda's petition; on file at DHES).

Surface water quality standards. Montana's surface water standards, shown in Table 4-13, are a combination of drinking water, aquatic life, and water and fish ingestion numeric standards [Administrative Rules of Montana §16.20.603 (25)]

Table 4-13. Montana water quality standards.

Parameter	Ground water† (mg/L)	Surface water* (mg/L)
Total dissolved solids	No standard	250
Total hardness	No standard	No standard
Total alkalinity	No standard	No standard
Ammonia	No standard	2.2§
Nitrate & nitrite¶	20/10	10/1
	Dissolved metals	*Total recoverable metals*
Aluminum	No standard	No standard
Arsenic	0.05	0.00002
Cadmium	0.005	0.0003†
Chromium	0.1	0.011†
Copper	No standard	0.003†
Iron	No standard	0.3
Lead	0.05	0.0004†
Manganese	No standard	0.05
Mercury	0.002	0.000012
Silver	0.05	0.00012†
Zinc	No standard	0.027†

Sources: †ARM §16.20.203 (1);
*ARM §16.20.603 (25)
§Temperature and pH dependent
¶Nitrate standard of 20 mg/L in ground water is permissible if certain conditions are met [ARM §16.20.203 (1)]; nitrate concentration of 1 mg/L in surface water is based on ARM §16.20.633 which prohibits conditions which "produce undesirable aquatic life"
†Hardness dependent; values based on 20 mg/L hardness

and the prohibitions discussed in the Administrative Rules of Montana §16.20.633. In implementing these standards, the DHES requires analysis of total recoverable metals.

Montana surface water quality regulations also prohibit discharges that would "create conditions which produce undesirable aquatic life" [ARM 616.20.633(1)(e)]. Nitrogen is a nutrient and, under certain conditions, may stimulate the growth of algae in surface water. Generally, algal growth in freshwater is limited by nutrients such as nitrogen and phosphorus. Excessive algal growth may create nuisance conditions such as undesirable aesthetics, taste, and odors; interference with water treatment systems; blocked water diversion structures; increased production of surface foams; and increased fluctuations of dissolved oxygen and pH. Under extreme conditions, these fluctuations may result in violation of numeric criteria for dissolved oxygen and pH. These effects are primarily a result of increases in biomass (mass per area).

Natural algal communities are composed of a complex assemblage of many different algal species, resulting in a high species diversity. Excessive nitrogen compounds may favor nitrogen-loving species and result in a less diverse algal community and/or excessive amounts of algae which are aesthetically unpleasant and interfere with fishing and wading.

Excessive algal growth and extreme shifts in community structure could impair beneficial uses of Libby Creek and its tributaries. There are no state or federal numeric standards for protection of this use. The EPA (1986) has recommended the use of 1.0 mg/L nitrogen in flowing water as a maximum guideline for the protection of these uses. Although nuisance conditions have been observed at much lower concentrations in streams which are slow flowing and relatively warm, or in streams which have relatively constant flows and temperatures, such effects would be limited in the Libby Creek system

because of the swift current and variations in temperature.

The DHES has used the preceding considerations and several other factors in coming to its judgement as to the maximum concentration of soluble nitrogen that would not result in "undesirable aquatic life" in Libby Creek and its tributaries. It is the judgement of the DHES, based on current knowledge, that the instream concentration of soluble inorganic nitrogen (NO_3 + NO_2 + NH_3, as N) in Libby Creek and its tributaries should not exceed 1.0 mg/L. This is necessary to prevent the growth of undesirable aquatic life in Libby Creek and its tributaries and, thus, to comply with ARM 16.20.633(1)(e).

Montana surface water quality standards require that industrial wastes receive, as a minimum, treatment equivalent to best practicable control technology currently available (BPCTCA), or the equivalent of secondary treatment (ARM §16.20.631) as determined by the DHES. Under Montana regulations, the BPCTCA incorporates by reference federal treatment standards as defined in 40 CFR Subchapter N which specifies effluent limitation for mining and milling discharges and, in cases where the BPCTCA is not defined by the EPA, industrial wastes must receive a minimum of secondary treatment or equivalent as determined by the DHES.

The BPCTCA for removal of sediments and associated metals has been defined for mining and milling operations. Those treatments are not effective for removal of nitrogen, however, and because nitrogen is a nutrient which has the potential to cause undesirable aquatic growths in surface waters, the DHES is required pursuant to ARM 16.20.631 to make a determination regarding what constitutes secondary treatment or equivalent for nitrogen removal. The DHES has not made this determination. Technologies which may be considered secondary treatment include reverse osmosis, ion exchange, properly designed land application or treatment, evaporation or combination of one or more of these or other technologies. (Other technologies may exists which could also be considered secondary treatment for nitrogen. These technologies, however, have not been evaluated by the DHES).

Ground water quality standards. For ground water, the applicable standards are the primary drinking water standards established by the Environmental Protection Agency under the Safe Drinking Water Act (Table 4-13). Montana adopted these standards for all ground water in the state [Administrative Rules of Montana §16.20.203 (1)]. In implementing these standards, the Montana Department of Health and Environmental Sciences requires analysis of dissolved metals (dissolved and total recoverable metals are discussed in the subsequent *Geochemical Attenuation/Plant Uptake* section). For some metals, such as arsenic and mercury, the adopted surface water quality standard is lower than the analytical detection limit (the lowest concentration measurable by a laboratory using a particular analytical method).

The projected effects of Noranda's proposed discharges must acknowledge a number of uncertainties and assumptions used by the agencies in the analysis. These uncertainties are described in the following section. The impact assessment is discussed under *Alternative 1*, *Alternative 2*, and *Alternative 3* following the discussion of the uncertainties and assumptions.

Uncertainties Associated with the Water Quality Assessment

Changes in surface and ground water quality were projected using an analytical technique known as a loading analysis. The loading analysis estimates the increased mass or "load" of metals and other constituents in a receiving stream when discharges from the proposed operation are added. The resulting instream concentration of a particular parameter is projected by dividing the resultant load by the resultant streamflow. Projected ground water changes are calculated in a similar manner. This projection assumes complete mixing of the discharges and ambient

streamflow. Variables used in the loading analysis include flow rate and ambient water quality in the receiving stream, and information on the rate and water quality of the proposed discharges. Chapter 6 discusses the loading analysis in detail.

The loading analysis uses the estimated discharge water quality shown in Table 4-10 and the discharged quantities shown in Noranda's water balance (discussed in the previous *Streamflow* section) to predict water quality following mixing with ambient water quality at low flows (Table 4-11 and Table 4-12). Projections of surface water quality involve a number of uncertainties. These include the ambient and discharge water qualities, ambient water quantities, discharge water quantities, the exact location where surface water would be affected, the influence of existing ground water and soil conditions on discharged water quality, the length of time required for discharge to reach surface waters, and the environmental effect from increased metals concentrations on aquatic life. Because of the complexity of the water quality assessment, each of these uncertainties is discussed briefly in the following sections. Although discussed under surface water, most of these uncertainties also apply to the ground water impact assessment.

Ambient and discharged water quality. The actual quality of ambient and discharged water cannot be identified because concentrations of many parameters, particularly metals, are below the detection limits used for those parameters. Ambient water quality at low flow conditions is shown in Tables 4-11 and 4-12. Estimated quality of adit and mine water discharges, and tailings water seepage is shown in Table 4-10. The parameters with concentrations reported with a less than symbol (<) are those parameters with concentrations below the detection limit. The actual concentration for these parameters is unknown. For concentrations with a less than symbol, the value shown is the "detection limit" obtained by the analytical laboratory when analyzing the water sample. The detection limit is the lowest concentration of a parameter measurable by a laboratory using a particular analytical procedure. Different parameters and different samples may have different detection limits. For example, the laboratory Noranda used in analyzing surface water samples used an analytical method having a detection limit of 0.1 mg/L for aluminum and 0.0001 mg/L for cadmium. When a concentration is reported at less than the detection limit (<0.1 mg/L for aluminum for example), the actual concentration is unknown. In the case of aluminum, the actual concentration could be 0.099 mg/L (just less than the detection limit), or it could be a thousand times less, 0.0001 mg/L.

Detection limit data are important in the loading analysis in three ways. First, if concentrations of metals are below the detection limit, ambient concentrations are not known. If Noranda's discharges have concentrations below detection limits, changes in water quality may not be detectable.

Second, surface water quality standards for some parameters, such as arsenic, mercury, and silver, are lower than the detection limit (Table 4-13). It is not known, and can not be known using approved analytical methods, whether surface water quality standards for such metals are being exceeded under ambient conditions, or whether surface water quality standards would be exceeded as a result of Noranda's proposed discharges having concentrations below measurable levels.

Third, the use of the detection limit as the concentration used in the loading analysis may overestimate projected concentrations. It is the policy of the DHES to use the reported detection limits in a loading analysis for parameters with concentrations below the detection limit. This is the most conservative value to use, since the reported concentration could be either just less than the detection limit or considerably less. For example, the cadmium surface water quality standard is 0.0003 mg/L. The expected cadmium concentration for adit water is less than 0.001 mg/L (Table 4-10). The actual cadmium concentration in adit water is not

known, but is below 0.001 mg/L. The concentration used in the loading analysis—the detection limit—is 0.001 mg/L. As a result of using 0.001 mg/L when the actual concentration is unknown, projected cadmium concentration at station RA 600 under low flow conditions is <0.0005 mg/L, exceeding the surface water standard. If actual cadmium concentrations are sufficiently below the 0.001 mg/L used in the loading analysis, it is possible that the surface water standard for cadmium would not be exceeded by discharges from the proposed operations. Projected exceedances for other metals, such as arsenic, mercury, and silver concentrations, also are uncertain.

Detection limits lower than those shown for the ambient water quality (Tables 4-11 and 4-12) and estimated water quality for mine, adit and tailings discharges (Table 4-10) are available for some metals. As discussed Chapter 2, Noranda is using lower, more sensitive detection limits than previously used in analyzing surface and ground water samples beginning with the 1992 interim monitoring, and would use these detection limits during construction, operational, and post-operational monitoring.

Nitrate and ammonia concentrations. Tables are presented in the subsequent discussion of impacts showing applicable surface water quality standards, existing water quality at low flow conditions, and the projected water quality at low flow and average flow conditions. Each table presents projected water quality at low flow and average flow conditions using two different concentrations for expected nitrate and ammonia concentrations. Since the agencies are uncertain as to what concentrations of nitrate and ammonia in discharge water might be, projected concentrations using a "high range" and a "low range" are presented. Noranda's projected concentrations also are presented in the tables; these projections are contained in its supplemental petition information (Noranda Minerals Corp., 1992a). Noranda used a low range of expected nitrate concentrations in its loading analysis. There are other differences between the agencies' and Noranda's analyses; the impact analysis methods for both the agencies and Noranda are presented under *Hydrology* in the *Impact Assessment* section of Chapter 6.

Ambient water quantities. The loading analysis used calculated low and average flows for assessing impacts to surface water and the calculated groundwater flux for assessing impacts to ground water. Because of the short period of record, flows at the three surface water stations were estimated using a proportional drainage area adjustment of measured flows in Granite Creek (USGS, 1982). Actual low flows, during which highest concentrations probably would occur, may be different from those calculated. Lower low flows than those calculated would result in higher in-stream concentrations than those projected, if all other assumptions in the loading analysis occur.

Noranda's estimate of ground water flux is based on available data in the Ramsey Creek LAD area. In estimating ground water flux, an estimate of hydraulic conductivity is required. Ground water flux is directly related to hydraulic conductivity; higher conductivity results in higher fluxes. Noranda's estimate is based on hydraulic conductivity tests conducted in test pits in the LAD area (Noranda Minerals Corp., 1989h). The value for conductivity used in calculating flux was higher than that used for the tailings impoundment. If actual conductivities are lower than estimated, higher ground water concentrations than those projected would occur, if all other assumptions in the loading analysis occur.

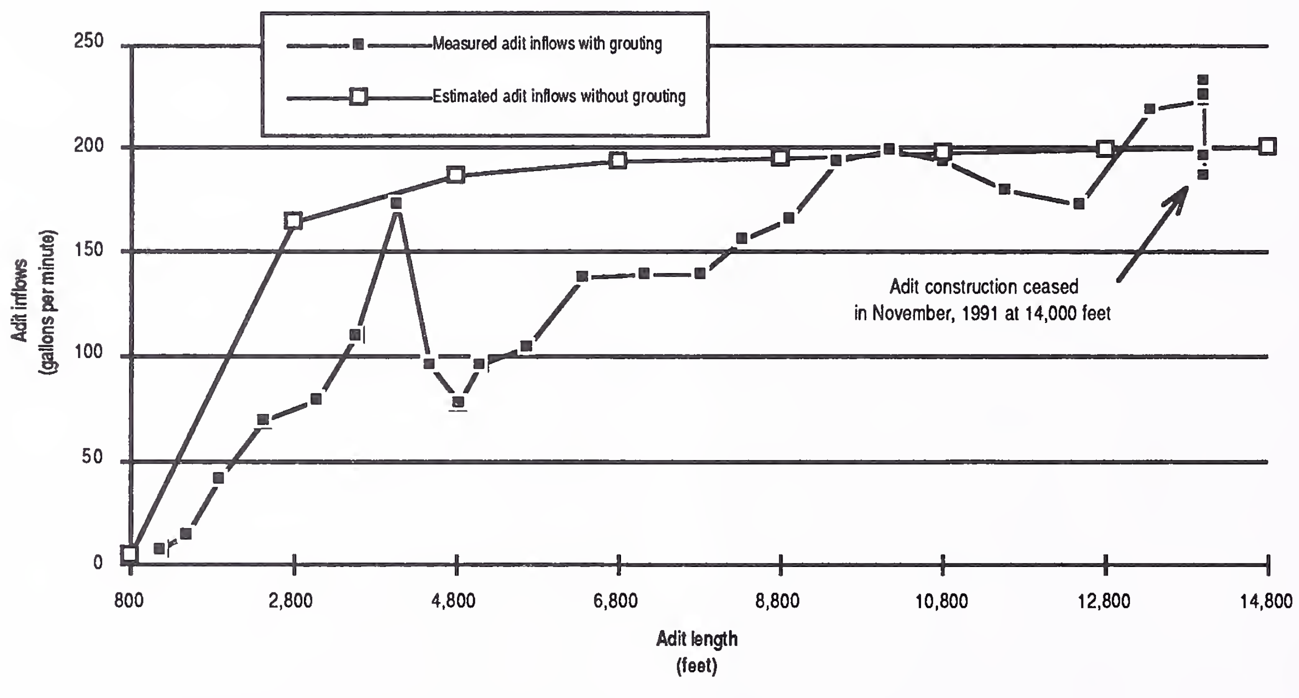
Discharged water quantity. Projected water quality is based on the discharged water quantities shown in Noranda's estimated water balance (Table 2-5). Discharged quantities used in the loading analysis include 542 gpm of adit water and 11 gpm of mine water in Year 3 of construction, and 187 gpm of adit water and 475 gpm of tailings seepage in Year 16. Noranda expects to collect tailings seepage (378 gpm in Year 16) to reduce the amount of seepage reaching surface water. Total ground water discharge in Year

16 is estimated at 280 gpm (97 gpm of tailings seepage and 183 gpm of adit discharge). Total ground water discharge in Year 18 is estimated at 280 gpm (207 gpm of discharge tailings water and 73 gpm of tailings seepage).

Noranda's water balance is a point estimate developed using reasonable methods and assumptions. Actual rates for a number of flow paths used in the balance, such as mine and adit inflows, precipitation and evaporation, and dust suppression, would vary seasonally and annually from the rates shown in the estimated water balance (Table 2-5). For example, Figure 4-2 shows measured inflows from the Libby Creek adit compared to the estimated inflows which form the basis for Noranda's estimated water balance. The measurements shown in Figure 4-2 exclude fresh water intake used for drilling, which ranged between 11 and 34 gpm. The estimates used in the water balance and in the loading analysis include additional flow added by Noranda as a safety factor.

Noranda's mine and adit inflow estimates assumed no grouting. Noranda has grouted extensively in the Libby Creek adit to reduce inflows and has estimated grouting effectiveness at 80 percent (DSL inspection report by W. Jepson, 12/11/91). Actual inflows without grouting would be considerably higher than those estimated. Noranda's estimates, however, are for "steady-state" conditions, or conditions which would occur over the long-term. Initial inflows are higher than steady-state conditions because water stored in saturated fractures and faults is initially released. It is not possible to know what actual "steady-state" adit inflows might be. Mine inflow estimates have the same uncertainty.

Figure 4-2. Relationship of estimated adit inflows versus measured adit inflows.†



† Inflow measurements do not include fresh water intake used for drilling.

Source: Noranda Minerals Corp., March 9, 1992 letter to DSL and monthly monitoring of Libby Creek adit; on file with the agencies.

Higher adit inflows may not have any effect on water quality during operations. Adit inflow water quality has very low metals and nutrient concentrations (Table 6-10 in Chapter 6). Increased adit inflows would dilute the amount of nitrate and ammonia resulting from blasting, and would lower the resulting nitrate and ammonia concentrations in discharged water. Higher mine inflows may affect water quality adversely, depending on the actual mine water quality. If increased mine inflows having the estimated mine water quality shown in Table 4-10 occur and require discharge, the agencies' projected water quality changes may underestimate actual changes. Sustained increased adit or mine inflows would limit Noranda's flexibility in handling excess water.

Tailings seepage estimates also may be too low or too high. For example, Noranda's water balance assumes that 475 gpm of tailings seepage would enter the underlying aquifer in Year 16. The estimated seepage rate, however, is based on preliminary engineering studies (Morrison Knudsen Engineers, Inc., 1989a) and may overestimate impoundment seepage. Based on additional geotechnical data collected in 1990 and additional analysis, seepage estimates range between 120 gpm and 300 gpm, depending on the thickness of the underlying aquifer (Morrison Knudsen Engineers, Inc., 1990c). Actual seepage would depend on the permeability of the soils underneath the impoundment, thickness of the underlying aquifer, and the total amount of water in the impoundment. Noranda conducted detailed geotechnical investigations to determine soil permeability within the impoundment area. These investigations provide the basis of Noranda's estimate. It is an estimate, however, and actual seepage rates probably would be different.

The hydrologic and geologic conditions of the tailings impoundment area are complex. As noted by Morrison-Knudsen Engineers, Inc. (1990c), "Complete definition of the hydrogeologic system at the site probably would not be possible. Costs associated with substantial definition of the hydrogeologic system would be prohibitive because of the size of the system and its complexity." It was recognized by Noranda that it is not possible to fully define the thickness, lateral extent, continuity and permeability of either the fine-grained confining soil strata or the more permeable water-bearing strata associated with the artesian groundwater conditions beneath the site. This lack of surety in the definition of subsurface conditions is the primary uncertainty about the effectiveness of the proposed pressure relief/seepage interception well system, due to the associated lack of surety in the selection of the locations, depths and screened intervals of the relief wells. The dam construction method, consisting of raising of the starter dam with cycloned tailings sands in the downstream direction, further complicates the siting of such wells.

Because of uncertainties in the operational water balance and the discharge rates, the agencies would require extensive monitoring of operational flows and discharges (see *Water Balance* section in Appendix B–Monitoring). If the observed discharges are greater than currently estimated, a new loading analysis would be performed to determine if additional mitigations would be required.

Water quality assessment locations. Noranda's discharges to ground water would occur in two locations—at the Ramsey Creek land application disposal areas, and at the Little Cherry Creek impoundment area. (Discharges also may occur at the Libby Creek percolation pond/land application disposal area if Libby Creek adit water quality is equal to or better than ambient water quality.) Some uncertainty is associated with which streams would be affected by discharges at the other two locations. Water applied at the Ramsey Creek LAD area would discharge either to Ramsey, Libby, and/or Poorman creeks. In the supplemental petition information, Noranda estimated that 83 percent of the water discharged at the LAD area would go to Ramsey Creek, 7 percent to Poorman Creek, and 10 percent to Libby Creek (Noranda Minerals Corp., 1992a). These estimates are based on measured ground water levels at the LAD area.

In projecting impacts on surface water quality, the agencies used monitoring stations on Ramsey Creek (RA 600) and Poorman Creek (PM 1000). A station on Libby Creek (LB 2000) was used to project cumulative effects. If more than 83 percent of the water disposed at the Ramsey Creek LAD area discharges to Ramsey Creek, the impacts to Ramsey Creek would be more than those projected and the impacts to Poorman Creek would be less. In addition, one well (WDS-4) in the Ramsey Creek LAD area was artesian. Because the artesian conditions in the LAD area have not been fully defined, it is unknown what effect these conditions may have on the ground water flows in the area.

The complexity of the hydrogeologic system at Little Cherry Creek leads to uncertainty with two aspects of the water quality assessment—the location of the seepage discharge to ground water and the effectiveness of Noranda's proposed seepage interception system. In the agencies' analysis, it was assumed that all ground water from the tailings pond would discharge in adjacent reaches of Libby Creek. Currently, some ground water discharges to Little Cherry Creek where it supports perennial streamflow. The agencies also assumed that Noranda's pressure relief/seepage interception system would be sufficient to "dewater" or eliminate flow in Little Cherry Creek and the creek would no longer be a perennial stream and support aquatic life. However, if the seepage collection system is less efficient than anticipated, some seepage from the tailings impoundment may discharge to lower Little Cherry Creek. In either event, tailings seepage would enter Libby Creek upstream of station LB 2000, the monitoring location the agencies used to assess impacts from all upstream activities including the tailings impoundment seepage.

Soil attenuation. Soils have the capability to remove metals and other constituents from water. This capability, called soil attenuation, is discussed in a subsequent section under Alternative 1 entitled *Geochemical Attenuation/Plant Uptake*. The expected discharges as well as the existing surface water have relatively low concentrations of metals and other constituents. Because of the low metals concentrations, it is not known what the effectiveness of soil attenuation would be. It would vary depending on the particular metals, and would vary over time. For example, copper might be removed by attenuation to a greater degree than manganese. Studies conducted by Noranda indicate that the site soils have a significant capacity to attenuate both copper and manganese (Camp, Dresser & McKee, Inc., 1992). Copper was reduced to concentrations about 20 times lower than adit/mine water and manganese was reduced initially about 10 times lower than adit/mine water in column tests. Clayey soils, such as those prevalent in the tailings impoundment area, have a greater attenuation capacity than sandy soils. All soils, however, have a limited attenuation capacity. As a result, soil attenuation might decrease over time. For example, during tests conducted by Noranda, manganese concentrations in water percolating through soil samples collected from the project area gradually increased to levels comparable to adit/mine water, indicating the soils had reached their adsorption capacities (Camp, Dresser & McKee, Inc., 1992). The length of time before soil attenuation would no longer be effective cannot be determined.

Two processes would reduce ammonia concentrations substantially—soil attenuation and nitrification (the oxidation of ammonia to nitrate). Nitrates would occur not only from ammonia oxidation, but also would be elevated in discharged waters (Table 4-10). Nitrate concentrations would be reduced by plant uptake during the growing season. Ammonia and nitrates are discussed in greater detail in the subsequent *Geochemical Attenuation/Plant Uptake* section.

Due to the uncertainties associated with attenuation and to be conservative in analyzing impacts, the agencies assumed no attenuation of metals, and no attenuation or nitrification of ammonia, would occur. Projected concentrations discussed under Alternative 1 are based on these assumptions.

Time. It is not known how long it would take the discharges to reach surface waters. The agencies assumed that the discharges would be instantaneous, essentially a direct discharge into the receiving stream. Depending on the actual flow path, flow may take several decades to reach and discharge into the receiving stream (see *Ground Water Hydrology* section).

Environmental effects on aquatic life. There is some uncertainty associated with the concentrations at which metals affect aquatic life in the project area. Montana surface water quality standards shown in Table 4-13 are based on a hardness of 20 mg/L $CaCO_3$; actual hardness ranges between about 5 and 25 mg/L $CaCO_3$. Environmental effects on aquatic life from those metals which are hardness related (cadmium, chromium, copper, lead, and silver) may occur at concentrations less than those shown in Table 4-13. This issue is discussed in detail under *Fish and Other Aquatic Life*.

Noranda's Contingency Plan

In response to the uncertainties, Noranda would maintain a detailed water balance to monitor water inflows and outflows to the various project components (the details have been incorporated in the agencies' monitoring program in Appendix B). Chapter 2 summarizes Noranda's proposed contingency plan to handle excess water, to provide additional makeup water, or to increase seepage interception. Noranda has committed to maintaining surface water quality below applicable standards in all potentially affected streams (Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek and Libby Creek). A monitoring program has been proposed by Noranda to evaluate operational effects to water quality and aquatic life.

Grouting in the adits and mine areas, and storing of excess water in the tailings impoundment are Noranda's primary mechanisms for handling excess water. Grouting can reduce inflows substantially, probably more successfully in the adits than in the mine. Noranda has grouted extensively during the Libby Creek adit construction. The effectiveness of grouting in relative terms is unknown.

The tailings impoundment has the capacity to store not only tailings, but excess water as well. Noranda has calculated, and the agencies have confirmed, that the impoundment has between 1.5 and 4 years of excess water storage, assuming the values for mine and adit inflows, precipitation and evaporation are as shown in the water balance. This storage capacity is the lowest in Year 1 of operations and reaches the maximum in Year 16. The impoundment storage capacity would provide Noranda with the ability to manage the seasonal and annual fluctuations in the various components of the water balance.

Noranda's contingencies for controlling water quality include a proposed pressure relief/seepage interception system, and increased land application. Noranda would use an "observational approach" to the installation of the proposed seepage interception system. An initial set of wells would be installed, and additional wells installed as needed based on monitoring results. The proposed system does not initially include using pumps to increase seepage; Noranda has indicated pumps would be used if necessary. As discussed previously, the agencies have some concerns that Noranda's proposed seepage interception system may not perform as planned.

Noranda has indicated in the supplemental petition information that additional land application disposal areas are available (Noranda Minerals Corp., 1992a). Areas around the impoundment, such as unused areas proposed for borrow, could provide additional space for land application. Noranda indicated these areas could be used if unacceptable water quality occurs in the Ramsey Creek LAD area.

Reasons for Developing Alternatives 2 and 3

The agencies developed modifications to Noranda's proposal in response to the uncertainties associated

with the impact assessment. Alternative 2 would include—

- changing the impoundment design to reduce tailings seepage into ground water;
- developing a representative underground sampling and acid-base testing program on rock from the adits, ore zones, above and below the ore zones, and in the barren (lead) zone;
- conducting analysis of mine, adit and tailings water for additional metals that could have environmental effects on aquatic life; and
- implementing the more detailed hydrology and aquatic life monitoring program described in Appendix B.

In addition, Alternative 3 incorporates most Alternative 2 modifications (gravel drains would not be installed if the impoundment would be lined). Alternative 3 also includes treating some or all excess water prior to discharge, or developing additional land application disposal areas. Specifically, the agencies developed three options for managing and treating excess water—

- Option A–full lining of the impoundment and mechanical treatment of all excess water;
- Option B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Option C–alternative water management/land application treatment of all excess water.

The impoundment would not be lined under Options B and C. If monitoring data indicates water quality standards have been or would be violated, the agencies could require Noranda to treat excess water or collected seepage water with a mechanical water treatment system similar to the ones described under Options A and B in addition to implementing the specific measures contained in Noranda's contingency plan.

The quality of the post-operations mine water cannot be projected accurately at this time. Therefore, Noranda would be required to monitor mine water quality during operations to develop a better estimate of post-operational water quality. A variety of treatment technologies are potentially available (including lime treatment, sulfide treatment, evaporation, reverse osmosis, ion exchange, and artificial wetlands) should post-operations mine water require treatment before discharge.

ALTERNATIVE 1

The agencies' analysis of Alternative 1 is divided into three phases—the construction phase, the operational phase and the post-operational phase. The *Construction Phase* section describes projected water quality prior to mill operation, estimated by Noranda to be a three-year period. The *Operational Phase* section discusses projected impacts during Year 16 when maximum discharges during operations would occur. The *Post-operational Phase* section describes projected water quality during Year 18 (2nd post-operational year) when maximum discharges of tailings water are expected to occur (see Table 2-5 in Chapter 2 for project water balance).

Construction Phase

During construction, water entering the adits (542 gpm) and the mine (11 gpm) would be discharged to the Ramsey Creek LAD area. Water quality information from stations PM 1000, RA 600, and LB 2000 was used to predict surface water quality resulting from this discharge. During the construction phase, increases are projected to occur in total dissolved solids, total hardness, total alkalinity, nitrogen compounds (ammonia, nitrate, and nitrite), and some metals under low and average flow conditions (Tables 4-14 through 4-16).

At all three stations, the projected concentrations of total dissolved solids, ammonia, and nitrate would exceed existing concentrations. Surface water quality standards for ammonia would be exceeded at low flow conditions in Ramsey Creek and Libby Creek using the high range of ammonia concentrations. A nitrate concentration of 1 mg/L also would be exceeded in Ramsey, Poorman, and

Libby creeks at low flow conditions regardless of the nitrate concentration used in the analysis. An increase in nitrate and ammonia concentrations may cause increased growth of algae (see *Fish and Other Aquatic Life* section). Nitrates would be reduced significantly during the growing season, and ammonia probably would be retained by the soil or rapidly converted to nitrate (see *Geochemical Attenuation/Plant Uptake* section). Ammonia oxidation to nitrate could increase in-stream concentrations of nitrates over that projected. Although total hardness and total alkalinity would increase, standards have not been established for these two parameters.

Measured nitrate concentrations in Libby Creek below the Libby Creek adit LAD area are shown in Figure 4-3. Measured nitrate concentrations reached a maximum of 6.8 mg/L in October, 1991 at a flow in Libby Creek of 1.95 cfs, or 875 gpm. The agencies compared measured nitrate concentrations with those that would be projected using a loading analysis. In the analysis, the agencies used an expected nitrate concentration of 40.7 mg/L in adit water, a discharge of 200 gpm of adit water, a flow in Libby Creek of 1.95 cfs and other assumptions used in the loading analysis (see Chapter 6). Projected nitrate concentrations using these assumptions would be 7.6 mg/L, close to the measured concentration of 6.8 mg/L.

Table 4-14. Projected surface water quality changes in Ramsey Creek (station RA 600) following discharge of adit and mine water (Year 3 of construction).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow: agencies' analysis	Projected water quality at low flow: Noranda's analysis	Projected water quality at average flow: agencies' analysis	Projected water quality at average flow: Noranda's analysis
	(mg/L)					
Total dissolved solids	250	<10	<99	<94	<20	<19
Total hardness	No standard	<6	<33	<28	<9	<9
Total alkalinity	No standard	7	49	38	12	11
Ammonia (high range)	2.2	<0.1	<11.1	—	<1.4	—
Ammonia (low range)			<3.4	<1.1	<0.5	<0.2
Nitrate/nitrite (high range)	10/1§	0.07	16.9	—	2.0	—
Nitrate/nitrite (low range)			5.2	5.2	0.7	0.7
Aluminum	No standard	<0.1	<0.2	<0.1	<0.1	<0.1
Arsenic	0.00002	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0005	<0.0005	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.004	<0.020	<0.001
Copper	0.003	<0.002	<0.008	<0.005	<0.003	<0.002
Iron	0.3	<0.05	<0.10	<0.07	<0.06	<0.05
Lead	0.0004	<0.001	<0.005	<0.001	<0.001	<0.001
Manganese	0.05	<0.02	<0.03	<0.03	<0.02	<0.02
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	<0.0002	<0.0006	<0.0003	<0.0002	<0.0002
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

Table 4-15. Projected surface water quality changes in Poorman Creek (station PM 1000) following discharge of adit and mine water (Year 3 of construction).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow agencies' analysis	Projected water quality at low flow Noranda's analysis	Projected water quality at average flow agencies' analysis	Projected water quality at average flow Noranda's analysis
	(mg/L)					
Total dissolved solids	250	25	37	27	26	16
Total hardness	No standard	<12	<16	<14	<12	<11
Total alkalinity	No standard	18	24	22	18	18
Ammonia (high range)	2.2	<0.05	<1.7	—	<0.2	—
Ammonia (low range)			<0.5	<0.6	<0.1	<0.5
Nitrate/nitrite (high range)	10/1§	0.04	2.5	—	0.2	—
Nitrate/nitrite (low range)			0.8	0.8	0.1	0.1
Aluminum	No standard	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.001	<0.020	<0.001
Copper	0.003	0.001	<0.002	<0.002	≤0.001	<0.001
Iron	0.3	<0.05	<0.06	<0.05	<0.05	<0.05
Lead	0.0004	<0.001	<0.002	<0.001	<0.001	<0.001
Manganese	0.05	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	<0.0003	<0.0003	<0.0002	<0.0003	<0.0002
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

Table 4-16. Projected surface water quality changes in Libby Creek (station LB 2000) following discharge of adit and mine water (Year 3 of construction).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow: agencies' analysis	Projected water quality at low flow: Noranda's analysis	Projected water quality at average flow: agencies' analysis	Projected water quality at average flow: Noranda's analysis
	(mg/L)					
Total dissolved solids	250	33	56	52	35	31
Total hardness	No standard	29	34	32	29	29
Total alkalinity	No standard	32	41	38	33	32
Ammonia (high range)	2.2	<0.05	<3.3	—	0.3	—
Ammonia (low range)			<1.0	<0.4	0.1	<0.1
Nitrate/nitrite (high range)	10/1§	0.03	5.0	—	0.4	—
Nitrate/nitrite (low range)			1.5	1.5	0.2	0.2
Aluminum	No standard	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.002	<0.020	<0.001
Copper	0.003	0.001	<0.003	<0.002	≤0.001	<0.001
Iron	0.3	<0.05	<0.06	<0.05	<0.05	<0.05
Lead	0.0004	<0.001	<0.002	<0.001	<0.001	<0.001
Manganese	0.05	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	0.0003	<0.0004	<0.0003	≤0.0003	<0.0003
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

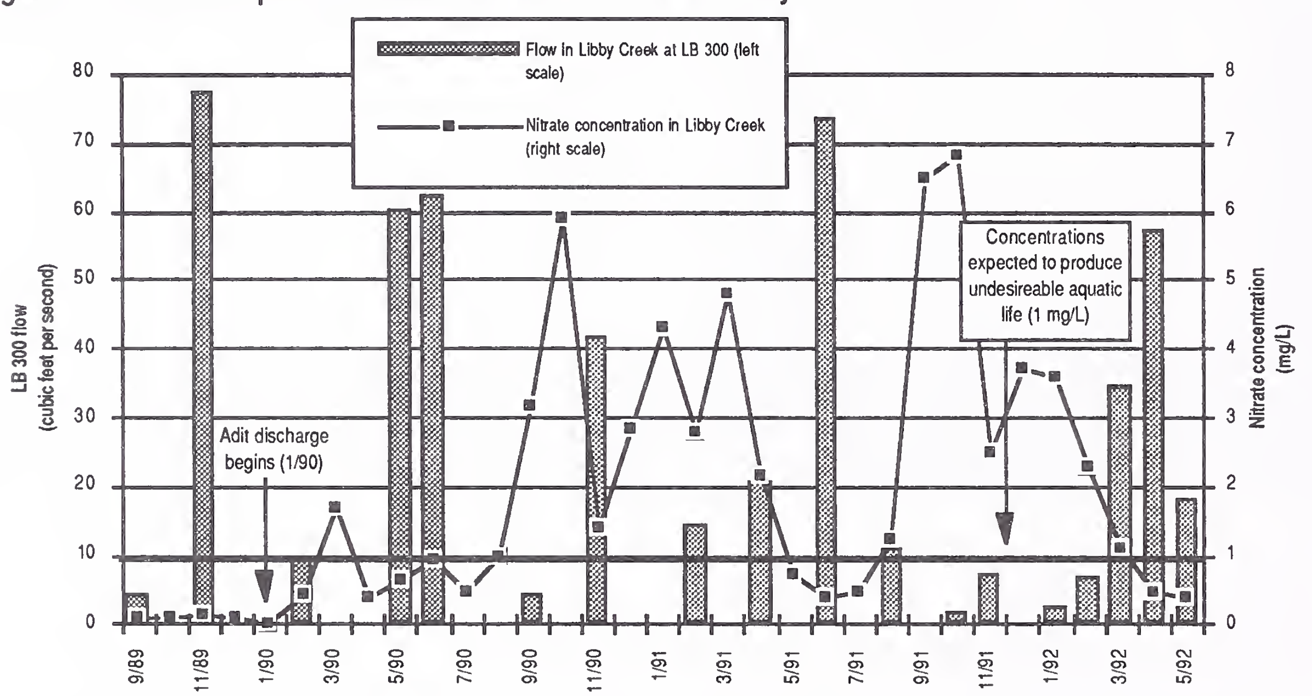
Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

Projected ammonia concentrations, however, did not compare favorably to measured concentrations. Highest measured ammonia concentrations at LB 300 was 0.63 mg/L (Chen-Northern, Inc., 1992a). Using the same analysis, projected ammonia concentrations would be 5.1 mg/L. As previously discussed, ammonia probably oxidizes rapidly to nitrate, or is attenuated by the soils. The agencies' expected ammonia concentration of excess water also may be too high.

The agencies analyzed the relationship between estimated stream flow and projected nitrate concentrations. Coupled with this analysis was an analysis of the percent of time various stream flows occur. As shown in the preceding tables presenting projected water quality, projected concentrations of nitrate (as well as all other constituents) are higher at low flow conditions than at "average" flow conditions. Higher average flows provide greater dilution, and result in lower projected concentrations. Table 4-17 presents the flows at which specified nitrate concentrations are projected to occur. For example, 1 mg/L nitrate at RA 600 is projected to occur at a flow of 43.8 cubic feet per second (cfs) using a high range and at a flow of 12.2 cfs using a low range.

The U.S. Geological Survey has developed "flow duration curves", or percent of time different flows occur, for Granite Creek based on measured flows. Noranda and the agencies used the average and low flows measured at Granite Creek to calculate average and low flows for the impact assessment locations, PM 1000, RA 600, and LB 2000 (see Chapter 6). Assuming that Ramsey Creek has the same distribution of flows as those measured at Granite Creek, the percent of time various concentrations of

Figure 4-3. Relationship of nitrate concentrations and flow in Libby Creek at LB 300†



†Flow measurements in Libby Creek were not taken every month. Where not shown, flow was not measured.

Source: Chen-Northern, Inc. 1989, 1990, 1991a
Noranda Minerals Corp., monthly monitoring of Libby Creek; on file with the agencies.

nitrate would be exceeded during Year 3 of construction is shown in Table 4-17. For example, 1 mg/L nitrate at RA 600 is projected to be exceeded 86 percent of the time based on a high range of nitrate concentrations and 62 percent of the time based on a low range of nitrate concentrations. The difference is the result of the uncertainty in estimated nitrate concentration of adit, mine and tailings water (see Chapter 6).

The loading analyses project that concentrations of aluminum, cadmium, copper, iron, lead, manganese, and silver may exceed ambient concentrations at RA 600 during low flow conditions (Table 4-14). Ambient concentrations of some of these metals also would be exceeded at PM 1000 and LB 2000 during low flow conditions (see Table 4-15 and Table 4-16). The standards for some metals, such as arsenic, chromium, lead, mercury, and silver, at the impact assessment locations are projected to be exceeded (see Table 4-15 and 4-16 for Poorman Creek and Libby Creek). For these metals, exceedances may not actually occur. As previously discussed, projected exceedances are a function of the concentrations (detection limit concentrations) used in the loading analyses.

Operational Phase

Mine and adit inflows would be used in the operations to the extent possible. All inflows initially would be used in the mill. Starting in Year 10, however, Noranda anticipates using all mine water in the mill, and discharging the better quality adit water to the Ramsey Creek LAD area as excess water. Water may be discharged at the Libby Creek percolation pond/land application disposal area if discharged water quality is equal to or better than ambient water quality. Tailings pond seepage also would occur during operations. This seepage would enter the shallow ground water system and ultimately discharge to Libby Creek. The monitoring station below the impoundment, LB 2000, would be affected by ground water discharges from both the impoundment and LAD area.

Although adit water discharged to the LAD areas would ultimately discharge to upper Libby Creek (LB 800), Poorman Creek (PM 1000) or Ramsey Creek (RA 600), the discharge would be less than that expected during construction. Since the effects at either PM 1000 or RA 600 would be less than that shown in Tables 4-14 and 4-15, a loading analysis of the operational adit water discharged at these

Table 4-17. Percent of time projected nitrate concentrations would be exceeded in Ramsey Creek (station RA 600) following discharge of adit and mine water (Year 3 of construction).

	high range		low range	
Projected nitrate concentration (mg/L)	Flow at which nitrate concentration is projected to occur† (cfs)	% of time projected nitrate concentration would be equalled or exceeded	Flow at which nitrate concentration is projected to occur† (cfs)	% of time projected nitrate concentration would be equalled or exceeded
1	≤43.8	86	≤12.2	62
2	≤20.5	74	≤5.4	31
4	≤9.6	57	≤2.1	5
5	≤7.4	46	≤1.5	2
10	≤3.2	14	—	0

Source: Agencies' analysis by IMS Inc. 1992.
†Analysis assumes no plant uptake of nitrates; nitrate concentrations would be reduced significantly during the growing season.

locations was not conducted.

By Year 16, Noranda anticipates that 183 gpm of excess adit water would be discharged to the LAD area and that seepage from the impoundment would reach 475 gpm (Table 2-5). Noranda estimates 378 gpm of impoundment seepage would be intercepted by the pressure relief/seepage interception wells, reducing the amount of seepage ultimately reaching Libby Creek. Seepage entering the ground water system and not intercepted by the collection system (97 gpm) and seepage through the impoundment diversion dam and the south saddle dam (6 gpm) would ultimately enter Libby Creek.

Projected surface water quality changes in Libby Creek at station LB 2000 during Year 16 of operations are shown in Table 4-18. Under low flow and average flow conditions, increases are projected to occur in total dissolved solids, total alkalinity, and ammonia. The projected increases would be below applicable standards. Projected nitrate concentrations (1.1 mg/L) would exceed 1 mg/L during low flow conditions based on a high range of nitrate concentrations.

Copper, lead, and manganese are projected to exceed ambient concentrations during low flow conditions. Arsenic, chromium, lead, mercury, and silver are projected to exceed surface water quality standards. As discussed under the construction phase analysis, these exceedances are a function of the metals concentrations of tailings and adit water used in the loading analysis. It is possible that the surface water quality standards for these metals would not be

Table 4-18. Projected surface water quality changes in Libby Creek (station LB 2000) following discharge of adit water and seepage of tailings water (Year 16 of operations).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow: agencies' analysis	Projected water quality at low flow: Noranda's analysis	Projected water quality at average flow: agencies' analysis	Projected water quality at average flow: Noranda's analysis
	(mg/L)					
Total dissolved solids	250	33	45	—	34	—
Total hardness	No standard	29	31	—	29	—
Total alkalinity	No standard	32	39	—	33	—
Ammonia (high range)	2.2	<0.05	<0.7	—	<0.1	—
Ammonia (low range)			<0.5	—	<0.1	—
Nitrate/nitrite (high range)	10/1§	0.03	1.1	—	0.1	—
Nitrate/nitrite (low range)			0.7	—	0.1	—
Aluminum	No standard	<0.1	0.1	—	0.1	—
Arsenic	0.00002	<0.005	<0.005	—	<0.005	—
Cadmium	0.0003	<0.0001	<0.0001	—	<0.0001	—
Chromium	0.011	<0.02	<0.020	—	<0.020	—
Copper	0.003	0.001	<0.002	—	<0.001	—
Iron	0.3	<0.05	<0.05	—	<0.05	—
Lead	0.0004	<0.001	<0.0014	—	<0.0010	—
Manganese	0.05	<0.02	<0.03	—	<0.02	—
Mercury	0.000012	<0.0002	<0.0002	—	<0.0002	—
Silver	0.00012	0.0003	<0.0003	—	<0.0003	—
Zinc	0.027	<0.02	<0.02	—	<0.02	—

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
— = Noranda did not conduct a loading analysis based on discharges in Year 16.
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

exceeded by discharges from the proposed operations. Actual surface water quality would depend on actual concentrations in discharge waters, actual ambient concentrations in Libby Creek and other factors previously discussed.

As discussed under *Streamflow*, Little Cherry Creek may cease to be a perennial stream and flow intermittently. Seepages from the seepage collection pond, which would collect seepage through the impoundment dam, may partially offset the reduced ground water discharge. Seepages from the collection pond would have quality similar to that expected for tailings water (Table 4-10). If this seepage reaches Little Cherry Creek, additional collection wells would be needed downstream of the seepage collection pond to collect this seepage and reduce surface water quality impacts.

Post-Operations Phase

Mining is expected to last about 16 years. Beginning in the first year after operations cease, Noranda would discharge excess tailings water to the Ramsey Creek LAD area. Some excess tailings water also would be stored in the impoundment. Noranda estimates that maximum discharge of excess tailings water (207 gpm) would occur in Year 18. This water would be discharged at the Ramsey Creek LAD area. An estimated 73 gpm of tailings seepage would not be intercepted by the seepage interception system in Year 18, for a total ground water discharge in Year 18 of 280 gpm. These discharges would affect water quality in Ramsey Creek (RA 600), Poorman Creek (PM 1000), and Libby Creek (LB 2000); projected water quality are shown in Tables 4-19, 4-20, and 4-21, respectively.

Table 4-19. Projected surface water quality changes in Ramsey Creek (station RA 600) following discharge of tailings water (Year 18, post-operations).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow: agencies' analysis	Projected water quality at low flow: Noranda's analysis	Projected water quality at average flow: agencies' analysis	Projected water quality at average flow: Noranda's analysis
	(mg/L)					
Total dissolved solids	250	<10	<45	<44	<13	<12
Total hardness	No standard	<6	<14	<15	<7	<8
Total alkalinity	No standard	7	42	42	10	10
Ammonia (high range)	2.2	<0.1	<5.9	—	<0.6	—
Ammonia (low range)			<3.5	<2.1	<0.4	<0.2
Nitrate/nitrite (high range)	10/1§	0.07	8.8	—	0.8	—
Nitrate/nitrite (low range)			5.1	4.1	0.5	0.4
Aluminum	No standard	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	<0.005	<0.004	<0.004	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.005	<0.020	<0.001
Copper	0.003	<0.002	<0.004	<0.004	<0.002	<0.001
Iron	0.3	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	<0.02	<0.11	<0.11	<0.03	<0.03
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

Table 4-20. Projected surface water quality changes in Poorman Creek (station PM 1000) following discharge of tailings water (Year 18, post-operations).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow agencies' analysis	Projected water quality at low flow Noranda's analysis	Projected water quality at average flow agencies' analysis	Projected water quality at average flow Noranda's analysis
	(mg/L)					
Total dissolved solids	250	25	29	19	25	15
Total hardness	No standard	<12	<13	<12	<12	<11
Total alkalinity	No standard	18	22	22	18	18
Ammonia (high range)	2.2	<0.05	<0.7	<0.7	<0.10	<0.5
Ammonia (low range)			<0.4		<0.08	
Nitrate/nitrite (high range)	10/1§	0.04	1.0	0.5	0.11	0.1
Nitrate/nitrite (low range)			0.6		0.08	
Aluminum	No standard	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.001	<0.020	<0.001
Copper	0.003	0.001	<0.001	<0.001	<0.001	<0.001
Iron	0.3	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	<0.02	<0.03	<0.03	<0.02	<0.02
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	<0.0003	<0.0003	<0.0002	<0.0003	<0.0002
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

At all three stations, the projected concentrations of total dissolved solids, ammonia and nitrate and nitrite would exceed existing concentrations. Based on the agencies' projections, surface water standards for ammonia would be exceeded at low flow conditions in Ramsey Creek and Libby Creek. A nitrate concentration of 1 mg/L also would be exceeded in Ramsey, Libby and Poorman creeks at low flow conditions. Ammonia probably would be retained by the soil, used by plants, or converted to nitrate (see *Geochemical Attenuation/Plant Uptake* section). Ammonia oxidation to nitrate could increase in-stream concentrations of nitrates over that projected. Although total hardness and total alkalinity would increase, standards have not been established for these two parameters.

The loading analyses project that concentrations of copper and manganese may exceed ambient concentrations at all three impact assessment locations at low flow conditions. The surface water quality standard for manganese at RA 600 is projected to be exceeded at low flow conditions. For these metals, exceedances may not actually occur. As previously discussed, projected exceedances are partly a function of the detection limit concentrations used in the loading analyses.

Seepage from the tailings impoundment would decrease after mining is complete. The tailings would be very low in sulfide content. The vast majority of sulfides would be removed from the ore during processing. Neutralizing minerals, moreover, would not be removed during flotation and would be contained in the tailings. It is therefore doubtful that

Table 4-21. Projected surface water quality changes in Libby Creek (station LB 2000) following discharge of tailings water (Year 18, post-operations).

Parameter	Surface water quality standard	Existing water quality at low flow†	Projected water quality at low flow agencies' analysis	Projected water quality at low flow Noranda's analysis	Projected water quality at average flow agencies' analysis	Projected water quality at average flow Noranda's analysis
	(mg/L)					
Total dissolved solids	250	33	43	39	34	30
Total hardness	No standard	29	30	30	29	29
Total alkalinity	No standard	32	42	41	33	33
Ammonia (high range)	2.2	<0.05	<1.9	—	<0.2	—
Ammonia (low range)			<1.1	<0.7	<0.1	<0.1
Nitrate/nitrite (high range)	10/1§	0.03	2.8	—	0.2	—
Nitrate/nitrite (low range)			1.6	1.3	0.2	0.1
Aluminum	No standard	<0.1	0.1	0.1	0.1	0.1
Arsenic	0.00002	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.011	<0.02	<0.020	<0.002	<0.020	<0.001
Copper	0.003	0.001	<0.002	<0.002	≤0.001	<0.001
Iron	0.3	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Manganese	0.05	<0.02	<0.05	<0.05	<0.02	<0.02
Mercury	0.000012	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.00012	0.0003	≤0.0003	<0.0003	≤0.0003	<0.0003
Zinc	0.027	<0.02	<0.02	<0.02	<0.02	<0.02

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Existing water quality based on agencies' analysis; Noranda used different existing water quality.
Metals concentrations shown for existing water quality are total recoverable; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).
§The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).

the tailings would become acid-generating in the future. It is not currently possible to predict accurately the quantity or quality of post-mining discharge from the mine adits. Noranda proposes to plug the adits, however, if monitoring indicates that the mine water discharge would not meet applicable water quality standards. (see *Ground Water Hydrology* section.)

Geochemical Attenuation/Plant Uptake

The previous discussion concerning the uncertainties of the water quality impact assessment briefly discussed attenuation, a chemical process through which soils remove metal and other ions from ground water. Some attenuation would occur in the soils in the LAD area and in the tailings impoundment area. Because the amount of attenuation that would occur cannot be estimated accurately, the water quality projections discussed in prior sections assumed that no attenuation would occur. In addition to attenuation, some plant uptake of nitrogen compounds also would occur during the growing season. The agencies' analysis also assumes that no plant uptake would occur.

Noranda's discharges of excess water would contain both metals dissolved in the water (called dissolved metals), and metals attached to sediments and other particles (called total recoverable metals in this discussion). Ground water usually transports metals in the dissolved form; consequently, ground water is usually analyzed for dissolved metals. Metals concentrations of ground water samples presented in Chapter 3 are dissolved. Since sediments are transported by surface water, surface water quality

samples are analyzed for total recoverable metals. Since Noranda's discharges have elevated concentrations of suspended sediments, there is a concern that metals attached to these sediments could affect water quality.

The agencies' analysis of these issues is provided in the following section. It provides information on the relationship of total recoverable metals to dissolved metals in proposed discharge water, the possible effects of total recoverable metals on surface and ground water quality, the ability of soils to attenuate metals and other constituents in discharge waters, and uptake of nitrogen by plants.

Total recoverable and dissolved metals. As noted in Table 4-13, Montana water quality standards use a dissolved metals analysis for enforcement of ground water quality standards, and a total recoverable metals analysis for enforcement of surface water quality standards. Since Noranda's discharges would first enter ground water before reaching surface waters, the loading analysis used dissolved metals concentrations for all discharges [estimated mine, adit and tailings water (Table 4-10)]. Analysis for dissolved constituents involves a sample filtered through a very fine pore-size (typically 0.45-microns). The sample is then acidified and sent to the laboratory for analysis. Saturated and unsaturated soil, through which the discharged water would travel, is typically a more effective filter than a man-made filter. Essentially, all non-dissolved constituent particulates (total suspended solids) are filtered out as the water passes through the ground water system.

Non-dissolved particulates typically include freshly precipitated compounds and minerals (e.g. iron oxyhydroxide); bits of organic debris and microbiota containing adsorbed metals; and metal-containing soil particles. The freshly precipitated minerals, particularly iron, aluminum and manganese oxyhydroxides, remain in the discharge water as fine particles (0.1 to 10 micron in diameter) until they either coagulate with other particles and eventually precipitate out or are attached onto the soil particles as they pass through the ground water system. Soils readily remove even these fine-grained particles within a very short distance from infiltration. Therefore, in a ground water system, the dissolved and total recoverable concentrations are essentially the same concentrations. In a surface water system, however, all total suspended particulates can be transported easily since the surface system typically lacks the filtering capacity to remove these particles as effectively as a ground water system.

Analysis for total recoverable constituents is conducted on an unfiltered water sample. The procedure involves a sequence of rigorous acid digestions that effectively puts most non-dissolved materials into solution. Therefore, the total recoverable analysis includes not only the dissolved constituents, but also some of the non-dissolved particulates.

Table 6-11 and Table 6-12 in Chapter 6 presents both dissolved and total recoverable water quality data for Libby Creek adit discharges. Trace metals with greater total recoverable concentrations include copper, iron, manganese, and aluminum. Iron, manganese and aluminum precipitate as oxyhydroxides when exposed to the near neutral pH and oxygenated surface water conditions. Trace metals that are reported at or near the detection limits include copper, cadmium, lead and zinc. These metals are likely adsorbed onto the iron, manganese and aluminum oxyhydroxides. The rigorous digestion process for the total recoverable method dissolves these oxyhydroxides. This process releases the adsorbed (non-dissolved) trace metals into solution and they become part of the reported total recoverable metals concentrations.

For adit water, nearly all dissolved metals concentrations are below detection limits, indicating a mineralogy that produces only extremely small amounts of dissolvable material. The Montanore Project ores contain little iron sulfide. Acid generated would not be enough to dissolve the metals

in the ore. The small amount of acid that would be produced would be quickly neutralized because the pH of the milling system would be about seven.

The above oxidation, precipitation and adsorption processes commonly reduce, attenuate or remove metals from hydrologic systems. Applying the metals-bearing water to the soils and allowing the water to infiltrate into the ground water (for example, in a land application disposal area) allows the processes to attenuate and potentially remove metals from solution. These processes are very active in the soil and ground water systems. In-situ microbiota and organic matter add to the attenuation process, especially for copper and cadmium. Since metals concentrations would be extremely low, and the pH level of excess water would be near neutral, the soils should have adequate capacity to reduce metals concentrations under near surface oxidizing conditions.

Nitrogen compounds. Besides metals, the discharge waters would also contain nitrogen compounds, such as nitrates and ammonia. Nitrogen compounds would be used in the blasting explosives. The amount of nitrates and ammonia in the discharged waters would increase immediately following underground blasting and decrease until the next blasting. Estimated nitrate concentrations shown in Table 4-10 are based on all available analytical results. Nitrates and ammonia concentrations may be higher than estimated, particularly following blasting.

Four mechanisms would tend to reduce ammonia concentrations following discharge to the land application disposal areas—immobilization by soil microbes, bacterial oxidation to nitrate (nitrification), uptake by plants, and attenuation by soil particles. Immobilization and nitrification are the two dominant processes affecting ammonia concentrations. The rate and amount of ammonia used in each process depends on numerous factors such as soil type, vegetation cover, moisture conditions, and temperature. During the growing season, nitrification occurs rapidly (one to two days); little nitrification occurs during cold periods.

Nitrates not only would occur in discharged waters, but also would be formed by the oxidation of ammonia. Nitrates would either be used by plants or leached into the underlying ground water. Ammonia nitrate is common agricultural fertilizer. During the growing season, a four-to-six month period in the project area, much of the nitrate may be used by the vegetation in the LAD areas (Vitousek et al., 1979). Noranda estimates that 450 pounds of nitrogen per acre could be used (Schafer and Associates, 1992). The amount of nitrates used by plants in an LAD area would depend on timing of application, total amount of nitrogen applied, and type of vegetation. Younger, less mature forests with open canopies and greater shrub and grass understory would use more nitrogen than more mature forest or those with less herbaceous understory. During the winter, little plant uptake and increased leaching would occur.

Under Alternative 1, the agencies assumed that no nitrogen compounds (ammonia or nitrate) would be used by plants. Noranda has proposed year-round discharge of excess water, reducing the effectiveness of plant uptake of nitrogen compounds. Under Alternative 3, the agencies have modified Noranda's proposed land application treatment system to include only seasonal discharge of excess water (see Option C under *Alternative 3*). Restricting land application of discharge water to the growing season would reduce significantly the amount of ammonia and nitrates reaching ground water and subsequently surface water. Noranda has estimated that 80 percent of applied nitrogen would be used by plants at the rates proposed for disposal (Schafer and Associates, 1992). Actual reductions would depend on the previously discussed variables.

Beneficial Use

During construction, surface water would remain suitable for irrigation, and livestock use (Table 4-22). Under Alternatives 1 and 2, the 10 mg/L

nitrate/nitrite drinking water standard would be exceeded in Ramsey Creek and Libby Creek during low flow conditions during discharge of adit and mine water (Year 3 of construction) and during discharge of tailings water (after Year 17) using a high range of nitrate concentrations. The agencies estimate that 10 mg/L nitrate could be exceeded about 14 percent of the time in Ramsey Creek during Year 3 if the high range of nitrate concentrations occur (see Table 4-17).

If actual nitrate concentrations in discharge waters are less, the 10 mg/L drinking water quality standard would not be exceeded at any location. For example, if actual nitrate concentrations in discharge waters are 23.5 mg/L (the low range of nitrate concentrations), projected nitrate concentration in Ramsey Creek would be about 5 mg/L. Regardless of the range of nitrate concentrations, nitrate concentrations are projected to exceed 1 mg/L in Libby and Ramsey creeks under Alternatives 1 and 2. The DHES has established 1 mg/L as the concentration at which undesirable aquatic life (algal growth) in area streams

Table 4-22. Water quality standards by specific beneficial use.

Parameter	Montana primary drinking water (mg/L)	Montana secondary drinking water (mg/L)	EPA¶ primary drinking water (mg/L)	EPA¶ secondary drinking water (mg/L)	EPA¶ proposed drinking water (mg/L)	Aquatic life (chronic) (mg/L)	Water and fish ingestion (mg/L)	Irrigation water§ (mg/L)	Livestock (mg/L)
Total dissolved solids	—	500	—	—	—	—	250	—	3,000
Ammonia	—	—	—	—	—	2.2	—	—	—
Nitrate/nitrite	—	—	100¶	—	—	1‡	—	—	—
Nitrate	10	—	10	—	—	—	10	—	100
Nitrite	—	—	1¶	—	—	—	—	—	10
Sulfate	—	250	—	—	400/500*	—	—	—	—
Aluminum	—	—	—	0.05-0.2	—	—	—	5.0	5.0
Arsenic	0.05	—	0.5	—	—	—	0.000022	0.1	0.2
Arsenic (pent)	—	—	—	—	—	0.00048	—	—	—
Arsenic (tri)	—	—	—	—	—	0.00019	—	—	—
Cadmium	0.01	—	0.005	—	—	0.0003	0.01	0.01	0.05
Chromium (total)	0.5	—	0.1	—	—	0.011	0.05	0.1	1.0
Copper	—	1.0	1.3†	1.0	—	0.003	—	0.2	0.5
Iron	—	0.3	—	0.3	—	—	0.3	5.0	—
Lead	0.05	—	0.015†	—	—	0.0004	0.05	5.0	0.1
Manganese	—	0.05	—	0.05	—	—	0.05	0.2	—
Mercury	0.002	—	0.002	—	—	0.000012	0.000144	—	0.01
Molybdenum	—	—	—	—	—	—	—	0.01	—
Silver	0.05	—	—	0.1	—	0.00012	0.05	—	—
Zinc	—	5	—	5	—	0.027	—	2.0	25

Sources: 40 CFR 141 and 142; 56 FR 26460; U.S. EPA, 1991; National Academy of Sciences, 1972; ARM 16.20.203 (1); ARM 16.20.603 (25)

§Continuous use, all soils.

¶Some recent revisions to EPA's drinking water standards have not been adopted by Montana.

‡The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e)

*The EPA has identified two possible standards in the proposed rule. One will be finalized after receiving comments.

†EPA's action levels, effective 11/6/91.

would be expected to occur. The projected ammonia concentrations also would exceed aquatic life standards in Libby and Ramsey creeks if the high range of ammonia concentrations occurs.

The aquatic life standard for several metals may be exceeded at the impact assessment stations under low flow conditions. Potential effects on aquatic life are discussed under the *Fish and Other Aquatic Life* section. During operations, surface water would remain suitable for drinking water, irrigation, and livestock use.

Kootenai River

The agencies compiled the available water quality information on the Kootenai River in the area of its confluence with Libby Creek (Tables 3-15 and 3-16 in Chapter 3). The following information describes anticipated effects to the Kootenai River from Noranda's proposed discharges. The *Fish and Other Aquatic Life* section describes anticipated effects to white sturgeon.

Measurable water quality effects are not expected in the Kootenai River as a result of the proposed project. At the maximum projected discharge (553 gpm or 1.23 cfs), Noranda's discharge would amount to less than 0.05 percent of the lowest minimum daily flow in the Kootenai River downstream of Libby Creek (3,120 cfs recorded in Water Year 1988). Noranda's discharges would have no significant effect on the Kootenai River flows.

The lowest monthly mean flow (4,001 cfs) in the Kootenai River occurred in March 1989. Using that flow and an average manganese concentration of 0.01 milligrams per liter (mg/L) as an example, 215 pounds per day of manganese were carried by the Kootenai River. Table 4-23 shows present metals loadings in the Kootenai River and the projected increases based on the quantity and quality of discharges described in the loading analysis. As shown in the "projected Kootenai River" column, Noranda's discharges would have an insignificant effect on metals loadings to the Kootenai River. Increased metals concentrations would not be significant and probably would not be detectable.

Table 4-23. Present and projected metals loading in Kootenai River.

Metal	Present load (Kootenai River)	Projected increase: Construction (Year 3)	Projected increase: Post-operations (Year 18)	Maximum projected load (Kootenai River)
	(lbs/day)			
Aluminum	—	1.96	0.34	—
Arsenic	21.55	0.03	<0.01	21.58
Cadmium	—	0.01	<0.01	—
Chromium	—	0.13	0.07	—
Copper	—	0.11	0.04	—
Iron	430.97	1.05	0.13	432.02
Lead	107.74	0.07	0.01	107.81
Manganese	215.48	0.32	1.51	216.99
Mercury	—	<0.01	<0.01	—
Silver	—	0.01	0.01	—
Zinc	215.48	0.20	0.07	215.68

Source: IMS, Inc., 1992.
†Metals marked with a "—" were not analyzed by the U.S. Geological Survey.

Reagents and Explosives

Using explosives in the mine and reagents in the milling process would affect surface water quality. Elevated ammonia and nitrate concentrations in the mine and tailings water would result from using explosives containing nitrogen compounds during mine and adit construction. Expected nitrate concentrations shown in Table 4-10 are based on measured nitrate concentrations in samples from the Libby Creek adit. Chapter 6 discusses the agencies' basis for the expected discharge water quality shown in Table 4-10. The effects of ammonia and nitrate on water quality have been previously discussed. A subsequent section, *Fish and Other Aquatic Life*, discusses the effects of ammonia and nitrate on fish and other aquatic life.

Limited information is available on effects of reagents on water quality. Reagents proposed by Noranda are relatively non-toxic at expected concentrations. Reagents proposed for use in the milling process, potassium amyl xanthate, cationic polyacrylamide flocculant, and methyl isobutyl carbinol (MIBC) are soluble and can be toxic to aquatic life at high concentrations. Noranda proposes to use annually 140 tons of potassium amyl xanthate, and 70 tons of flocculant and MIBC.

Noranda estimates about 10 percent of the xanthate reagent would be entrained in the tailings slurry, either dissolved in the liquid fraction or adsorbed to solids. The remainder would remain in the concentrate. Total concentration in the tailings is expected to be less than four parts per million (ppm). Under aerobic conditions, the xanthate itself is biodegradable. The dissolved fraction would tend to break down to less toxic simple organic compounds as a result of exposure to ultraviolet radiation and oxygen. Under reducing conditions, adsorbed xanthate within the tailings mass in the impoundment would be stable and immobile. The use of a flocculant would enhance adsorption and further tend to immobilize residual xanthate along with the tailings solids.

Potassium amyl xanthate is reportedly toxic to *Daphnia magna* (water flea) at concentrations as low as 0.1 ppm. Potassium amyl xanthate is much less toxic to other species studied, including trout (Hawley, 1977). Xanthate concentrations in tailings seepage probably would be too low to have any effect on receiving waters below the tailings impoundment. Dilution of tailings seepage with Libby Creek flows would decrease xanthate concentrations below 0.1 ppm. Increased potassium concentrations have been detected in the Troy tailings effluent; these may be the result of reagent use in the mill. Bioassays indicate that the Troy tailings water is generally not toxic or deleterious.

Noranda also estimates about 10 percent of the MIBC frother (Aerofroth® 70) would be entrained in the tailings slurry. The remainder would remain in the concentrate. Total concentration in the tailings is expected to be less than two ppm. MIBC is relatively non-toxic, with a reported toxicity range to fathead minnows (*Pimephales promelas*) of 100 ppm to 1,000 ppm (Hawley, 1977).

The polyacrylamide flocculant (Magnifloc® 491C) is relatively non-toxic, with a reported toxicity range for fathead minnows of greater than 1,000 ppm. The flocculant concentration in the tailings is expected to be less than 10 ppm. Most of the flocculant in the tailings would be entrained with the tailings solids and would be relatively immobile.

Acid Drainage

Acid drainage results from oxidation and metals leaching of sulfide bearing rocks when exposed to air and water. Not all rocks containing sulfide minerals will produce acid. Acid production depends on the amount and type of sulfides, the amount of neutralizing material available in the rock, site conditions and other factors. Acid drainage is the result of complex chemical and biological reactions. The development of acid drainage is time dependent and, at some sites, may evolve over a period of many years (British Columbia Acid Mine Drainage Task

Force, 1989). Drainage from acid-producing rocks typically contains elevated heavy metals that can adversely affect water quality and aquatic life. Potential sources of acid drainage for the Montanore Project are waste rock from the adits and mine to be stored on the surface and used in tailings embankment construction, ore temporarily stockpiled on the surface, ore and surrounding rocks exposed within the mine, and tailings deposited in the impoundment. All these rocks contain some sulfide minerals.

Acid drainage can be difficult to predict. There are several methods used in the prediction process. These include laboratory static geochemical tests, laboratory and field kinetic geochemical tests, and comparison with similar operating or abandoned mines.

Static acid-base analyses were conducted on rock samples to determine their acid-base potential. This method calculates the acid generation capacity based on sulfur analysis and offsets this value against the total neutralizing potential of the sample (British Columbia Acid Mine Drainage Task Force, 1989). Results of static testing are reported in terms of net neutralization potential or, as presented in Chapter 3, as acid-base potential. If there is more acid potential than neutralizing potential, then the acid-base potential is a negative number. A positive acid-base number results if there is more neutralizing than acid producing potential.

There are shortcomings with the static analysis method. The test is based on certain assumptions that may not be true. It assumes all sulfur in the rock is reactive and will all convert to acid; and that all the neutralizing potential is immediately available to counteract the acid. Because of these assumptions, rock with a negative acid-base number will not necessarily generate acid. Conversely, rock with a positive acid-base number may become acid generating.

The uncertainty in predicting acid generation potential is considered greatest when the acid-base value is between -20 and +20 (British Columbia Acid Mine Drainage Task Force, 1989). The average acid-base potential of rock samples collected and analyzed at Montanore is between -20 and +20. The acid-base potential for tailings also falls within this range. The range of individual rock sample values is -24 to +54. Based on the static test results, it is uncertain whether acid drainage would occur from the mine and adits.

Kinetic laboratory and field tests have not been conducted for these rocks. Such tests may be useful in predicting acid drainage potential, but uncertainty will still remain. Kinetic tests attempt to predict the rate of acid generation over time, usually over a period of months. Mathematical models are used to extrapolate the results over periods of many years, decades, or even centuries (British Columbia Acid Mine Drainage Task Force, 1989). These mathematical models are theoretical, however, and lack field data to verify whether the results they predict are valid.

The Troy Mine is probably the best predictive model for determining whether the Montanore Mine or tailings would become acid generating. Available information on the Troy deposit (Hayes, 1983) indicates that the mineralogy of both the ore and surrounding rock is very similar to that at Montanore. Ore sulfide minerals are the same at both deposits and are distributed in the same relative proportions. These minerals are chalcocite, bornite, and chalcopyrite. Both deposits exhibit similar sulfide zonation patterns, although the galena (lead sulfide) zone at Montanore may be thicker and higher grade than at Troy. The Troy deposit is in the upper Revett Formation; Montanore and ASARCO's proposed Rock Creek Mine are in the lower Revett Formation. Rock associated with all three deposits consists of quartzites, silty quartzites, and siltites. The proportion of these rock types is similar at all three deposits (ASARCO Rock Creek Completeness Response, April, 1988—on file with KNF). The Rock Creek deposit is located adjacent to and within the same lower Revett strata as Montanore. The proposed Montanore room-and-pillar mining

methods are similar to those used at Troy, as is the mill grind and flotation recovery process. Precipitation and temperature conditions are nearly the same for both sites.

Based on a comparison with the ASARCO Troy Mine, acid drainage from the mine and tailings should not occur at Montanore during project operations. Mine discharge and tailings water at ASARCO's Troy mine remains nearly neutral (see Chapter 6). Construction at the Troy Mine began approximately 13 years ago, and operations have been ongoing for over 10 years. The projected operating life at Montanore would be slightly longer than operations to date at Troy.

Raw ore would be stockpiled at the surface for a short period of time. The ore consists predominantly of copper (chalcocite) and copper-iron (bornite and chalcopyrite) sulfides within quartzite and siltite rocks. These sulfides are generally far less reactive than iron sulfides, such as pyrite and pyrrhotite. This is partly due to greater stability of their crystal structures and partly due to the formation of low solubility minerals which encapsulate them preventing further weathering (British Columbia Acid Mine Drainage Task Force, 1989). Temporary stockpiling of this low-reactive ore should not result in acid generation.

Noranda proposes to use adit waste rock in construction of the plant site and tailings embankment. This rock cannot be directly compared with waste rock from the Troy Mine because it is from different geologic formations. Some of the waste rock at Montanore would contain the iron sulfide pyrrhotite. The waste rock has the highest acid potential of all the rock units sampled, but it also has the highest amount of neutralizing potential. Analysis results indicate that Libby adit waste rock has an average net neutralizing potential of about +8.8 (Table 3-8, Chapter 3). This suggests that the rock would not generate acid, but falls within the -20 to +20 uncertainty range previously discussed. It is therefore possible that waste rock could become acid generating within the tailings embankment or at the plant site. Should acid generation occur, additional metals and other constituents may enter solution and affect surface water quality and aquatic life. The waste rock would be small in volume compared to volume needed to construct the entire tailings impoundment. Noranda proposes to continue sampling the waste rock for its acid-base potential and to segregate this material for underground disposal if it shows net acid generating potential.

The long term potential for acid rock drainage from the Montanore project is unknown. Static tests would not predict this potential with any certainty. Kinetic tests would be useful, but mathematical extrapolations of the test data cannot be verified at this time by actual field data. Water monitoring conducted over the operating life and during post-operations should detect any acid drainage, if it occurs, or trends in water chemistry indicating the potential for long term acid drainage. Monitoring information would be evaluated and water treatment or other appropriate methods implemented. Possible control and treatment options are discussed in the *Ground Water Hydrology* section in this Chapter.

ALTERNATIVE 2

The agencies' modifications to Noranda's proposal which would reduce surface water quality impacts or provide better monitoring of potential impacts from those described for Alternative 1 include—

- changing the impoundment design to reduce tailings seepage into ground water;
- conducting analysis of mine, adit and tailings water for additional metals that could have environmental effects on aquatic life;
- implementing a detailed hydrology and aquatic life monitoring program described in Appendix B; and
- developing a representative underground sampling and acid-base testing program on rock from the adits, ore zones, above and below the ore zones, and in the barren (lead) zone.

The impacts which would be associated with these modifications are described in the following sections. Other impacts associated with Alternative 2 would be the same as Alternative 1.

Changing the impoundment design to reduce tailings seepage into ground water, such as installing gravel drains, would reduce the amount of tailings seepage reaching ground water. Actual discharges to ground water from the tailings impoundment would depend on the final design of the system. Prior to construction, Noranda would submit final design of the system to the agencies for approval. Increases for various water quality parameters expected in Years 16 (Table 4-18) and Year 18 (Table 4-21) may be less, depending on the seepage reduction. Installing gravel drains or a similar system would reduce the uncertainty associated with tailings water quality and volumes and with the effectiveness of Noranda's proposed seepage interception system. The modification would provide Noranda the capability of managing tailings seepage before it would enter the underlying aquifer. Seepage quality also could be determined prior to mixing with ground water. If treatment is necessary to maintain surface water quality standards, seepage could be treated instead of recycled to the impoundment.

Noranda would expand the hydrology and aquatic life monitoring program, discussed in Appendix B. These changes would provide a better ability to detect changes in water quality and effects on aquatic life.

The agencies have included measures to reduce the uncertainties associated with acid drainage prediction. These measures would provide additional information used to predict the potential for long term acid drainage, and to assess the acid drainage potential of waste rock prior to its use as construction material. These measures rely largely on additional sampling and testing, including kinetic geochemical testing. As discussed previously, kinetic testing is useful in predicting acid drainage potential and verifying results of static tests, but there would still be uncertainties associated with the data.

Noranda would develop a representative underground sampling and acid-base testing program on rock from the adits, ore zones, above and below the ore zones, and in the barren zone. This information would be used along with water monitoring data to predict post-mining water quality. Kinetic test results of adit and mine waste rock proposed for use in plant site or tailings impoundment construction would be provided to the agencies prior to the rock being used for construction purposes. If this material is acid generating, it would not be used for construction purposes, but would be segregated for special handling. These measures would help ensure that acid generating material is not used for construction purposes. Adverse effects to water quality would be avoided by not using acid generating material for construction purposes.

ALTERNATIVE 3

Water Management and Treatment

The agencies developed three options for managing and treating excess water—

- Option A–full lining of the impoundment and mechanical treatment of all excess water;
- Option B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Option C–alternative water management/land application treatment of all excess water.

Each water management/treatment option is briefly discussed in the following sections and is followed by the agencies' impact assessment. Chapter 2 provides a more detailed discussion of these options.

Option A. Noranda would line the tailings impoundment and seepage collection pond with a synthetic or compacted clay liner. Seepage from the tailings impoundment and seepage collection pond would be essentially eliminated. Since the impoundment would be lined, a system to reduce seepage, such as gravel drains, would not be constructed. All other mitigations proposed as a part

of Alternative 2 would be incorporated with this option.

All excess water, before, during, and after operations, would be treated with a mechanical water treatment system. Post-operations treatment requirements would depend on quality and quantity of excess water. The agencies have identified, for the purposes of comparison, three systems—evaporator, ion exchange, and reverse osmosis—which could be used to treat water. Typical removal efficiencies for the three mechanical water treatment alternatives are shown in Table 2-13 in Chapter 2. Although excess water from the Montanore Project appears to be treatable with the proposed systems, there are no known examples using these systems in hard-rock mine or mill operations. Consequently, different removal efficiencies than those shown in Table 2-13 may occur.

The evaporator system would be the most effective of the three systems described in Chapter 2. Metals concentrations and nitrate concentrations would be reduced by 99 percent using an evaporator. Reverse osmosis would have similar removal efficiencies for metals, nitrates, and ammonia. Ammonia removal efficiencies in all three treatment systems, and removal efficiencies in general for the ion exchange demineralization system, would depend upon specific operating conditions and influent water quality.

Option B. Noranda would treat any excess mine, adit or tailings water with elevated nitrate and ammonia concentrations with a mechanical treatment system. Other excess water, specifically excess adit water with low nitrate and ammonia concentrations, would be discharged to a land application disposal area. Under this option, Noranda would not line the tailings impoundment, but would design a system to reduce seepage into the underlying ground water (see the gravel drain section under proposed mitigation for Issue 6 in Chapter 2).

Option C. Noranda would prepare a comprehensive water management/water treatment plan and submit the plan to the agencies during final design for review and approval. Water management would include storage of excess water during the winter months, and the discharge of excess water to LAD areas during the growing season. Additional LAD areas would be constructed in the tailings impoundment area. A more detailed monitoring program would be established to determine the actual nitrogen concentrations in the excess water as well as the effectiveness of the land application treatment system (see Appendix B).

Impact Assessment

The agencies' analysis of the three options under Alternative 3 is presented in the following sections. In the analysis of Options A and B, the agencies assumed that excess water with high nitrate/ammonia concentrations would be land applied at the Ramsey Creek LAD area following mechanical treatment. Under Option B, the analysis assumes excess water with low nitrate/ammonia concentrations would be land applied at the Ramsey Creek LAD area. Under Option C, the analysis assumes excess water with low nitrate/ammonia concentrations would be land applied at the Ramsey Creek LAD area and excess water with high nitrate/ammonia concentrations would be land applied at the Little Cherry Creek LAD area. Other assumptions are discussed in Chapter 6–Methods.

Construction phase. Projected nitrate and ammonia concentrations for Alternatives 3A, 3B, and 3C are shown in Table 4-24. Projected nitrate and ammonia concentrations in Ramsey and Libby Creek would be at or near ambient concentrations under Alternatives 3A and 3B. Nitrate concentrations in Libby Creek under Alternative 3C are projected to be 1.0 mg/L, based on a high range of nitrate concentrations. Using a high range of ammonia concentrations, projected ammonia concentrations in Libby Creek would be <0.7 mg/L. Ammonia and nitrate concentrations in Poorman Creek would be less than Ramsey Creek, using the same assumptions.

Under Alternatives 3A and 3B, an authorization by the Board of Health and Environmental Sciences probably would be required, allowing a change in total dissolved solids, nitrate and ammonia concentrations over ambient stream water quality. Water quality standards would be met using any of the mechanical treatment systems for those metals with water quality standards above detection limits. It is unknown whether the systems would achieve water quality standards for metals that have water quality standards below detection limits. Increases in other constituents, such as metals over ambient concentrations, also may occur even with water treatment, necessitating an authorization allowing a change in ambient water quality for these constituents.

If concentrations in treated water are equal to or less than concentrations in ambient surface water, treated water could be discharged directly to surface water and the land application disposal area would not be used. Noranda would be required to obtain a Montana Pollution Discharge Elimination System permit prior to any discharge to surface water.

Under Alternative 3C, the Board of Health and Environmental Sciences would have to approve Noranda's petition as revised in the supplemental petition information (Noranda Minerals Corp., 1992). The DHES will recommend to the Board that maximum concentrations of total inorganic nitrogen (nitrates, nitrites, and ammonia) in surface waters be limited to 1 mg/L. Using the agencies' assumptions and a high range of nitrate and ammonia concentrations, total inorganic nitrogen is projected to exceed 1 mg/L in Year 3 of operations (Table 4-24). Projected nitrogen concentrations are below 1 mg/L using a low range of nitrate and ammonia concentrations.

Noranda would conduct additional analysis of adit and mine waters to determine the average nitrate and ammonia concentrations in these waters during Year 1 of construction (discharge would be lowest in Year 1). Additional ground and surface water monitoring

Table 4-24. Projected nitrate and ammonia concentrations in Ramsey Creek (station RA 600) and Libby Creek (station LB 2000) following discharge of adit and mine water (Year 3 of construction).

	Alternative 1 Noranda's proposal Land application of all waters		Alternative 3A Impoundment lining/ mechanical treatment of all waters		Alternative 3B Mechanical treatment of high nitrate waters/land application of remainder		Alternative 3C Seasonal land application of all excess waters	
	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek
Nitrate								
High range	16.9	5.0	≤Ambient	0.1	0.1	0.2	0.1	1.0
Low range	5.2	1.5	≤Ambient	0.1	0.1	0.1	0.1	0.3
Ammonia								
High range	<11.1	<3.3	≤Ambient	<0.1	≤Ambient	<0.1	≤Ambient	<0.7
Low range	<3.4	<1.0	≤Ambient	<0.1	≤Ambient	<0.1	≤Ambient	<0.2

Source: Agencies' analysis by IMS Inc. 1992.
Note: The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).
Assumptions: All options assume all excess water with high nitrates and ammonia concentrations would be discharged at the Little Cherry Creek LAD areas;
90 percent of nitrate and ammonia would be removed from excess water by mechanical treatment; and
80 percent of nitrate and ammonia would be removed from treated water by land application treatment.

also would be instituted in the land application disposal areas to evaluate the effectiveness of land application treatment. Based on this monitoring (which is described in Appendix B of the FEIS), the agencies would evaluate the likelihood that surface or ground water standards would be exceeded in subsequent years with increased discharged volumes (Years 2 and 3 of construction). If monitoring indicates that ground or surface water standards are or would be violated, Noranda would be required to modify its operating plan. Several changes in Noranda's operating plan could be implemented if necessary to ensure protection of beneficial uses. Mechanical treatment using one of the three systems described under Alternative 3A could be required. Additional grouting could be implemented, reducing the total volume of excess water. Some excess water could be stored behind the impoundment dam and discharged at a reduced rate to improve the effectiveness of land application. Additional land application also could be implemented.

Operations phase. Without lining the impoundment, tailings seepage would enter underlying ground water and ultimately discharge to surface water throughout operations. With a liner, essentially no seepage would occur, and excess tailings water would be used in the mill. Excess adit water would be treated with a mechanical treatment system beginning in Year 8 and reaching a maximum of 268 gpm in Year 16. Projected ammonia and nitrate concentrations in all area streams during Year 16 of construction would be at or near ambient concentrations under all options.

Post-operations phase. Projected nitrate and ammonia concentrations for Alternatives 3A, 3B, and 3C are shown in Table 4-25. Projected nitrate and ammonia concentrations in Ramsey and Libby Creek would be at or near ambient concentrations under Alternatives 3A and 3B. Nitrate and ammonia concentrations in Ramsey Creek are also projected to be at ambient concentrations under Alternative 3C. Ammonia and nitrate concentrations in Poorman

Table 4-25. Projected nitrate and ammonia concentrations in Ramsey Creek (station RA 600) and Libby Creek (station LB 2000) following discharge of tailings water (Year 18 post-operations).

	Alternative 1 Noranda's proposal Land application of all waters		Alternative 3A Impoundment lining/ mechanical treatment of all waters		Alternative 3B Mechanical treatment of high nitrate waters/ land application of remainder		Alternative 3C Seasonal land application of all excess waters	
	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek	Ramsey Creek	Libby Creek
Nitrate								
High range	8.8	2.8	≤Ambient	0.1	≤Ambient	0.1	≤Ambient	0.6
Low range	5.1	1.6	≤Ambient	0.1	≤Ambient	0.1	≤Ambient	0.3
Ammonia								
High range	<5.9	<1.9	≤Ambient	<0.1	≤Ambient	<0.1	≤Ambient	<0.4
Low range	<3.5	<1.1	≤Ambient	<0.1	≤Ambient	<0.1	≤Ambient	<0.3

Source: Agencies' analysis by IMS Inc. 1992.
Note: The DHES established 1 mg/L as the concentration necessary to comply with ARM §16.20.633(1)(e).
Assumptions: All options assume all excess water with high nitrates and ammonia concentrations would be discharged at the Little Cherry Creek LAD areas;
90 percent of nitrate and ammonia would be removed from excess water by mechanical treatment; and
80 percent of nitrate and ammonia would be removed from treated water by land application treatment.

Creek would be less than Ramsey Creek, using the same assumptions. Nitrate concentrations in Libby Creek under Alternative 3C are projected to be 0.6 mg/L, based on a high range of nitrate concentrations. Using a high range of ammonia concentrations, projected ammonia concentrations in Libby Creek would be <0.4 mg/L.

Under all treatment systems, an authorization by the Board of Health and Environmental Sciences probably would be required, allowing a change in total dissolved solids, nitrate and ammonia concentrations over ambient stream water quality. Water quality standards would be met using any of the mechanical treatment systems for those metals with water quality standards above detection limits. It is unknown whether the systems would achieve water quality standards for metals that have water quality standards below detection limits. Increases in other constituents, such as metals over ambient concentrations, also may occur even with water treatment, necessitating an authorization allowing a change in ambient water quality for these constituents.

Secondary treatment may be required in perpetuity if tailings water has concentrations of metals or other parameters which, if discharged, would violate surface water quality standards. Treatment also may be required in perpetuity if tailings water has concentrations of metals or other parameters greater than ambient concentrations and the Board of Health and Environmental Sciences would not grant an authorization allowing a change in ambient water quality.

Under Alternatives 2 and 3, Noranda would conduct additional studies to provide a better estimate of post-mining adit and mine water quality. Noranda proposes to plug the adits if mine or adit water quality would be worse than ambient water quality. The agencies may require mechanical water treatment in perpetuity depending on the quality of mine water and the potential for acid formation.

Waste disposal. Options A and B would require the mechanical treatment of some or all excess water prior to discharge. In Chapter 2, the agencies discuss three systems which could be used–ion exchange, evaporator, and reverse osmosis. The evaporator system would result in a salt or salty brine which would require offsite disposal. The brine would be trucked offsite, and would be disposed at a publicly-owned water treatment facility, or a facility which handles hazardous waste. It is not known whether the salt would be considered hazardous waste. If metals in excess water become sufficiently concentrated, the salts could have metals concentrations that would be considered hazardous.

Ion exchange and reverse osmosis systems would produce a waste water that would require treatment and/or disposal. For a given volume of water to be treated, ion exchange system would produce a smaller volume of waste water than a reverse osmosis system. An ion exchange system would produce about 24,000 gallons per day under Option 3A, assuming a 3 percent brine production. This brine would require further treatment using an evaporator, or offsite disposal. The brine would be trucked offsite, and would be disposed at a publicly-owned water treatment facility, or a facility which handles hazardous waste. Camp, Dresser & McKee, Inc. (1992) identified mobile ion exchange units which would eliminate the transportation of waste brine. More detailed design for handling generated wastes would be required as part of final design of Alternatives 3A or 3B.

ALTERNATIVES 4, 5, AND 6

Surface water quality would not be affected by construction and operation of the transmission line. Slight increase in sediments may occur; these effects are discussed in the previous *Surface Water Hydrology* section.

CUMULATIVE IMPACTS

Cumulative impacts for all action alternatives would be similar. ASARCO's proposed Rock Creek project in the Rock Creek watershed would not affect

the quality of water in Libby Creek. No cumulative effects are anticipated on Libby Creek from the two separate mine operations.

RESOURCE COMMITMENTS

Under Alternatives 1 and 2, proposed discharges and tailings pond seepage would alter the water quality in Ramsey, Poorman, or Libby creeks, primarily by increasing the concentrations of total dissolved solids, metals and nutrients. Changes would be greatest during seasonal low flow periods. It is unknown how long surface water quality adjacent to the land application disposal areas would be affected after mining ceases. Increases would be less with mechanical water treatment systems proposed in Alternative 3.

Surface water quality effects would decrease following mining operations as impoundment seepage decreases. Some seepage from the impoundment would continue as long as the impoundment exists. The tailings are not anticipated to be acid generating, and the quality of the discharge would remain the same or improve with time. The abandoned mine workings would eventually fill with water and might discharge to the surface. The quality of this post-mining mine water discharge cannot be accurately predicted at this time. Under Alternative 1, Noranda would plug the adit unless the expected discharge would meet water quality standards (see following section). Under Alternatives 2 and 3, treatment may be required if water quality standards would be exceeded by discharges. Any change in water quality resulting from post-operational tailings seepage or mine and adit discharges would be an irreversible commitment of resources.

ALTERNATIVE 7

Projected water quality changes would not occur under Alternative 7. Flow from the Libby Creek adit would continue until the adit is reclaimed in accordance with the exploration permit issued by the DSL. Noranda has proposed plugging the adit as part of the reclamation plan if the mine is not constructed.

GROUND WATER HYDROLOGY

SUMMARY

As proposed in Alternative 1, discharge of excess water to ground water at the Ramsey Creek land application disposal area would occur during the three-year construction period, and beginning in Year 10 of operations. Based on the agencies' analysis, projected nitrate concentrations in ground water in the Ramsey Creek LAD area would be between 8 and 27 mg/L during the construction phase and between 9 and 18 mg/L during the post-operations phase; the upper range would violate the ground water quality standard for nitrate. During operations, seepage from the tailings impoundment would enter the shallow underlying aquifer, changing the ground water quality in the tailings impoundment area. Some seepage would be intercepted by Noranda's proposed pressure relief system, and the remainder would discharge ultimately to Libby Creek. The tailings impoundment would continue to seep in perpetuity. Tailings are not expected to be acid-forming, and tailings water quality would improve slowly with time. Wells downstream of project facilities would be used to monitor ground water quality.

During operations, Noranda would measure mine inflows. If substantial inflows occur, possible connection to surface water bodies would be evaluated. Noranda proposes to maintain a minimum distance of 500 feet from Rock Lake and 100 feet from the Rock Lake fault. These distances should provide adequate protection to surface water resources.

Following operations, water levels in the mine would rise until surface discharge occurs along natural pathways or at the mine adits. This water is expected to be relatively good quality; however, the potential for the generation of acid mine drainage exists. If acid mine drainage does occur, or if inflows to the underground workings indicate a surface connection, portal plugs would be constructed inside the mine adits.

Under Alternatives 2 and 3, Noranda would modify the impoundment design to reduce seepage beneath the impoundment. Gravels drains are an example of such a system which could be used under Alternatives 2, 3B, or 3C. Seepage into ground water and changes in ground water quality would be reduced; uncertainty associated with Noranda's seepage interception system also would be reduced.

Under Alternative 3A, the tailings impoundment would be lined with a synthetic liner. Tailings seepage would be extremely low. During operations, tailings water would be used in the mill, and any excess water requiring disposal would be adit water unaffected by blasting. Mechanical treatment would be used to treat any excess water before, during and after operations under Alternative 3A. Alternative 3B would require mechanical treatment of any excess water with elevated nitrate or ammonia concentrations. Changes in ground water under Alternatives 3A or 3B would be minimal. Elevated concentrations of nitrates would occur in the land application disposal areas under Alternative 3C.

The transmission line alternatives (4, 5, and 6) would not affect ground water. Ground water quantity and quality would remain unaffected under Alternative 7.

ALTERNATIVE 1

Mine Area

Ground water in the mine area occurs primarily in fractures (joints and faults) in bedrock. With the extension of the mine adits and eventually the mine workings below the water table, ground water would flow into the underground workings (mine inflows). Mine inflows would be greatest when a saturated fracture—or fracture system—is first encountered by the mine adit or workings. If not grouted, inflow from the fracture would soon decline as ground water stored in the fracture flows into the mine workings. Inflow would still continue from the fracture, but at a lesser rate. This rate would be equal to the rate of ground water recharge to the fracture or the same rate as steady state conditions. Noranda has estimated 542 gallons per minute would flow into the adits and an additional 656 gpm would flow into the mine workings in Year 16 of operations (Table 2-5 in Chapter 2).

It is not possible to predict the short-term, maximum inflow rates as individual fractures and fracture zones are encountered. The proposed mining operation has been designed to handle temporary mine inflows of 2,000 gpm. Noranda anticipates that mine water inflow would be used as makeup water in the process circuit. However, if sustained excess (>1,200 gpm) mine inflow occurs, Noranda has identified a number of measures which would be undertaken. These include fracture grouting, segregation of clean inflow waters, and temporary storage in the tailings impoundment (see Chapter 2, *Water Use and Management.*)

Mine inflows potentially would be greatest when mining encounters major faults or fault zones, such as the Libby Lake Fault. Major faults might act as

conduits for vertical ground water flow and provide a hydraulic connection between mine workings and overlying surface or ground water. Overlying surface and ground water resources could be drained if faults act as ground water conduits and Noranda's grouting program and barrier pillars are ineffective.

Underground collapse and decompressional fracturing might cause increased inflows into the mine. As discussed under *Subsidence* in the *Geology and Geotechnical* section, underground collapse might extend two to eight times the original mine height. A subsidence fracture may extend as much as 30 to 50 times the mining height. It is not known to what extent subsidence fractures, if they occurred, would intercept overlying ground and surface water. Subsidence often occurs without causing major damage to ground water or surface features (J.F.T. Agapito and Associates, Inc., 1991).

If the collapse zone and associated decompressional fracturing intersect natural fractures and faults not previously dewatered by the mine workings, increased mine inflows would result. Underground collapse would also reduce the long term effectiveness of Noranda's proposed fracture grouting program to control mine water inflow. During operations, Noranda would monitor mine water inflows and overlying lake levels (refer to Appendix B). Subsidence is not expected to occur as a result of the mining operation. (Subsidence is discussed further in the previous *Geology and Geotechnical* section.)

Following operations, mine water would no longer be pumped from the underground workings, and the mine workings would fill with water until the rate of inflow equals the rate of outflow. It is not known exactly how long it would take the mine to fill with water. Assuming inflows of 1,200 gpm and no outflows, the mine would take about 25 years to fill. Outflow would occur along natural pathways (fractures), or if water levels rise sufficiently, from the mine adits. Since the Libby Creek adit is located at a lower elevation than the Ramsey Creek adits, mine water discharge would likely occur there. Outflow from the adit would be sufficient to prevent further flooding of the mine workings.

The quality of the post-operations mine water cannot be projected accurately at this time. Noranda anticipates it would have a similar or better quality than mine water pumped from the workings during operations (Table 4-10). The post-mining water quality is uncertain, however, and it may exceed ambient water quality in receiving streams. In addition, the discharge might be acidic and contain higher concentrations of dissolved metals than currently expected. Acid generation primarily occurs as a result of sulfide mineral oxidation and bacterial action above the water table. Although sulfide minerals do not occur in large quantities in the ore and surrounding rock, these rocks might become acid generating (see preceding *Acid Rock Drainage* section). Acid generating potential would be somewhat reduced in those portions of the mine workings which would flood following operations. If discharge would occur from the Libby Creek adit, about 3,000 feet of workings would remain above the water level exposing any sulfide minerals to oxidation. Water quality largely would depend on the acid-generating potential of the barren (lead) zone, ore remaining in pillars, and surrounding rock within this portion of the mine.

In response to this uncertainty, Noranda would monitor inflow to underground workings during operations in order to predict whether the adits would discharge mine water following operations, and whether the expected flow would meet applicable water quality standards. If it is determined that there would be problems with the discharge, Noranda proposes to plug the adits following the cessation of operations.

Adit plugging is a technique used to control and redirect mine water flow. It does not prevent mine water discharge, however, and it is not a water treatment technique. When water quality is a concern, plugging may be combined with a water treatment

technology if necessary to direct mine flows. Water treatment technologies currently available for the treatment of mine water discharges include lime treatment, sulfide treatment, evaporation, reverse osmosis, ion exchange, and artificial wetlands. Power requirements of the treatment technology would be evaluated if and when an appropriate treatment technology has been selected.

If the adits are successfully plugged, the mine water would rise until the outflow along natural pathways equals the rate of mine water inflow. Ground water elevations may return to their pre-mining levels. Instead of one or two point-source discharges at the mine adits, mine water discharge would be more diffuse, occurring as springs and seeps, discharge to valley fill ground water systems, and/or baseflow in streams. If the adit plugs leak, the rise in mine water levels would be less. However, adit plugging would likely have little effect on the discharge water quality. Adit plugs have an expected life ranging from several decades to centuries. Without periodic inspection and maintenance, the adit plugs may eventually fail.

Land Application Disposal Area

Before mill operation, water would be pumped from the mine and adits and discharged to the Ramsey Creek LAD area. The excess water disposal system would have the capacity to store or discharge up to 2,000 gpm of excess water. Noranda estimates that adit and mine water discharges would reach 553 gpm in the third construction year. Seepage from the LAD area would enter shallow ground water systems discharging to Ramsey, Poorman or Libby Creek. Excess tailings water would be discharged to the LAD area beginning in Year 17, reaching a maximum of an estimated 207 gpm in Year 18. Projected ground water quality changes during Year 3 of construction and Year 18 are shown in Table 4-26.

Projected concentrations of total dissolved solids and nitrogen compounds over ambient concentrations

Table 4-26. Projected ground water quality changes in the Ramsey Creek LAD area (well WDS-1) following discharge of adit and mine water (Year 3 of construction) and following discharge of tailings water (Year 18, post-operations).

Parameter	Ground water quality standard	Existing water quality	Projected water quality at Year 3 agencies' analysis	Projected water quality at Year 3 Noranda's analysis	Projected water quality at Year 18 agencies' analysis	Projected water quality at Year 18 Noranda's analysis
	(mg/L)					
Total dissolved solids	No standard	50	168	159	106	106
Nitrate/nitrite (high range)	10	0.16	27.4	—	18.4	—
Nitrate/nitrite (low range)			8.4	8.2	10.6	8.4
Aluminum	No standard	<0.1	<0.2	<0.1	<0.1	<0.1
Arsenic	0.05	<0.005	<0.005	<0.005	<0.005	<0.003
Cadmium	0.005	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	0.1	<0.02	<0.020	<0.011	<0.020	<0.020
Copper	No standard	<0.02	<0.020	<0.013	<0.020	<0.017
Iron	No standard	<0.05	<0.13	<0.08	<0.05	<0.05
Lead	0.05	<0.01	<0.010	<0.004	<0.010	<0.006
Manganese	No standard	<0.02	<0.04	<0.03	<0.21	<0.21
Mercury	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	0.05	<0.001	<0.0011	<0.0005	<0.0010	<0.0006
Zinc	No standard	0.06	<0.06	0.04	<0.06	<0.04

Source: Agencies' analysis by IMS Inc. 1992; Noranda's analysis presented in Noranda Minerals Corp., 1992a.
†Metals concentrations shown for existing water quality are dissolved; both dissolved and total recoverable metals concentrations were used in developing projected water quality (see Chapter 6 for methods discussion).

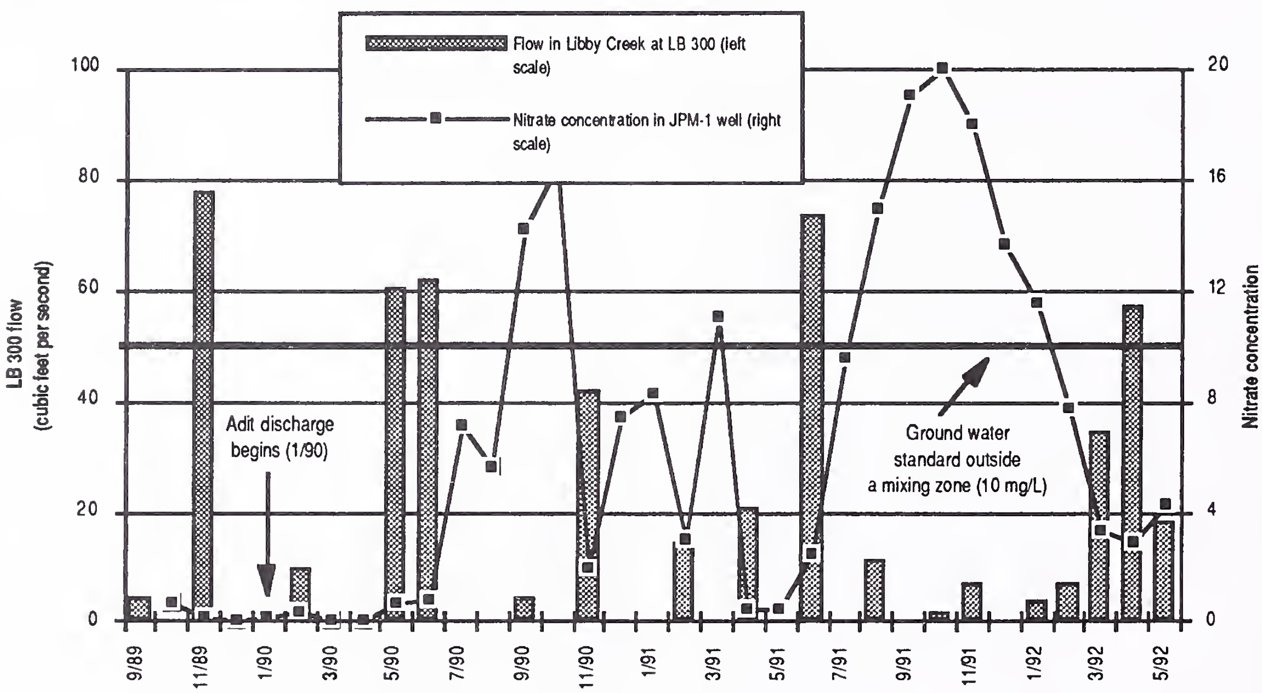
would occur in the land application disposal area. Projected concentrations of iron and manganese also would be higher than ambient concentrations.

Based on the high range in the agencies' analysis, these discharges would exceed nitrate standards for ground water outside the mixing zone allowed by Montana water quality regulations (Table 4-26). The mixing zone for ground water discharge in the Ramsey Creek land application disposal area would be the permit area boundary (see Figure 2-3 in Chapter 2).

Noranda has discharged Libby Creek adit water to a percolation pond/land application disposal area adjacent to Libby Creek since January, 1990. Measured nitrate concentration in a monitoring well (JPM-1) adjacent to the percolation pond at the adit site is shown in Figure 4-4. Because of the proximity of the well to Libby Creek (see Figure 2-5 in Chapter 2), nitrate concentration in the well was affected by the flow in Libby Creek. Highest nitrate concentrations were found in conjunction with fall low flows of Libby Creek. Well JPM-4, adjacent to the LAD area, had nitrate concentrations higher than JPM-1, with maximum nitrate concentrations of 42 mg/L in April, 1992. There is not adequate data to compare measured nitrate concentrations in the well near the Libby Creek LAD area to that which would be projected by a loading analysis.

After the mill becomes operational, adit and mine water would be used as makeup water in the process circuit. If mine inflows remain low, as projected, disposal of excess mine water would not be required. Inflow water such as that from the Libby Creek adit would be segregated and discharged starting in Year 10 of operations. By Year 10, discharged adit water quality would not be affected by blasting. Ground

Figure 4-4. Relationship of nitrate concentrations in JPM-1 well and flow in Libby Creek at LB 300†



†Flow measurements in Libby Creek were not taken every month. Where not shown, flow was not measured.

Source: Chen-Northern, Inc. 1989, 1990, 1991a
Noranda Minerals Corp., monthly monitoring of Libby Creek; on file with the agencies.

water quality following adit water discharge probably would not be affected.

Tailings Impoundment Area

The tailings impoundment is designed to seep to promote impoundment stability. Seepage would occur both through the bottom of the impoundment and through the embankment. Seepage moving through the embankment would be collected by the blanket drain and trunk drains and directed to a collection pond located downstream of the impoundment. Seepage would be impounded in a collection pond formed by a collection dam. Collected seepage would be pumped back to the tailings impoundment during the mine life.

Only the impounded tailings immediately adjacent to the tailings embankment would contribute seepage to the embankment and ultimately to the seepage collection pond. Following operations, the seepage collection dam would be removed when water quality standards would be met. It is not known what length of time would be required. Seepage through the embankment would enter the original Little Cherry Creek drainage as surface flows.

Seepage from the bottom of the tailings impoundment may enter the shallow ground water system, or emerge as springs and seeps near the tailings impoundment. The seepage rate would increase over the 16-year impoundment life, from approximately 50 gpm during Year 1 to an estimated 475 gpm in Year 16 (Table 2-5 in Chapter 2). Actual seepage may be more or less than projected. Tailings water emerging from springs and seeps around the impoundment boundary would be collected and pumped back into the impoundment. A portion of the seepage entering the glaciofluvial aquifer would be intercepted by the pressure relief/seepage interception system and pumped back to the impoundment.

Estimates of the potential effectiveness of the pressure relief well system in intercepting seepage were developed by Noranda (Morrison-Knudsen Engineers, Inc., 1990c; Noranda Minerals Corp., June 17, 1991—on file with the agencies). A simplified analysis was made for the final impoundment configuration. The analysis assumes that the extensive system of wells which would exist in the dam foundation would be equivalent to a single line of fully penetrating wells. Noranda estimates that 80 percent of the estimated impoundment seepage would be intercepted by the pressure relief/seepage interception system. Noranda also estimates that the water collected and recycled from the system, without pumping, would consist of 77 percent impoundment seepage and 23 percent ground water in Year 1 and 97 percent impoundment seepage and 3 percent ground water in Year 16. If the collection system is not as effective as anticipated by Noranda, additional seepage collection may be necessary to avoid exceeding surface water standards. Measures to control excess water, described in the *Noranda's Contingency Plan* section under *Surface Water Quality*, may be necessary if the seepage collection system does not perform as planned.

Water from the impoundment entering the underlying aquifer would discharge to the original Little Cherry Creek or Libby Creek. At an estimated ground water flow rate of 0.1 to 4 feet per day (Noranda Minerals Corp., 1989h), it may take up to several decades for ground water affected by seepage to reach Libby Creek. As discussed in the *Geochemical Attenuation/Plant Uptake* section, the ground water quality affected by tailings seepage may improve as it migrates through the soil and ground water system.

Following the cessation of mining, tailings would no longer be slurried to the tailings impoundment. Water recharging the tailings impoundment would consist only of infiltration from natural precipitation and runoff from adjacent areas, and water levels within the impoundment would drop until steady state conditions are achieved. Following reclamation, seepage would decrease and reach an estimated 70 gpm to 290 gpm at steady state conditions (Morrison-Knudsen Engineers, Inc., 1990d).

Lowering of water levels in the tailings impoundment would expose any sulfide mineralization in the tailings to oxidation and bacterial action. This could result in acid drainage and the release of dissolved metals to ground water (and indirectly to surface water). Initial testing of the tailings material, however, indicates a net neutralizing potential (Table 3-9). The tailings would have a low sulfide content. Although uncertainty exists, acid drainage from the tailings is not expected. Following operations, Noranda would monitor water quality in the vicinity of the tailings impoundment. If problems are identified, appropriate remediation would be implemented. Measures could include expanding the relief well system to increase seepage collection, water treatment and capping of the impoundment. Several current technologies applicable to the treatment of tailings seepage water are discussed in Alternative 3.

Evaluation of Noranda's Proposed Monitoring Program

Noranda has proposed an operational water resource monitoring program (see Chapter 2). The proposed monitoring programs would include surface water, and ground water sampling programs.

Operational monitoring would begin during the first quarter of operation of the mill and the tailings impoundment facility. The interim monitoring program has been implemented. Eleven surface water monitoring stations would be established on Libby, Ramsey, Poorman, Little Cherry and Bear creeks. Surface water samples would be collected seasonally, during spring low flow, spring high flow, late summer low flow, and fall low flow. No samples would be collected during the six-month period between fall low flow and spring low flow.

Ground water samples would be collected from 17 monitoring wells near the plant site and land application disposal area, the Libby Creek adit area, and the tailings impoundment area. Monitoring wells would be sampled seasonally.

Surface and ground water samples would be analyzed for field parameters (pH, specific conductance, and temperature), total dissolved solids, major and minor ions, nutrients, and trace metals. Surface water samples would be analyzed for total recoverable metals. Ground water samples would be analyzed for dissolved metals. The monitoring plan does not indicate if stream flow and water level measurements would be made when water samples are collected. The proposed monitoring plan includes both field and laboratory QA/QC programs to ensure the quality of the samples collected.

An annual report would be prepared to summarize information and data collected during the year. It is not clear if the annual report would include copies of laboratory reports (raw data) and the results of field and laboratory quality control programs. (This information is necessary for the regulatory agencies to determine if the monitoring results are useable.) Any actual or potential impact identified during routine monitoring would be reported immediately to the regulatory agencies.

ALTERNATIVE 2

Impacts of Alternative 2 would be similar to those discussed for Alternative 1. Mine area impacts would be the same. Under Alternative 2, Noranda would modify the design of the impoundment to reduce the amount of tailings seepage entering the underlying ground water. The agencies have evaluated gravel drains as an example of such a system. Gravel drains would capture tailings water prior to entering the underlying ground water. Gravel drains are in response to the uncertainty associated with Noranda's pressure relief/seepage interception system and would provide greater flexibility if tailings water quality is worse than expected. The actual amount of seepage reaching surface water may be the same for gravel drains and Noranda's proposed pressure relief/seepage interception system if both systems perform as anticipated.

ALTERNATIVE 3

The agencies developed three options for managing and treating excess water—

- Option A–full lining of the impoundment and mechanical treatment of all excess water;
- Option B–mechanical treatment of some excess water/land application treatment of remaining excess water; or
- Option C–alternative water management/land application treatment of all excess water.

These options are discussed in Chapter 2 and under *Alternative 3* in the *Surface Water Quality* section.

Under Alternative 3A, all excess water, before, during, and after operations, would be treated with a mechanical water treatment system. Removal efficiencies for three mechanical treatment systems are discussed in Chapter 2 and under *Alternative 3* in the *Surface Water Quality* section. Ground water in the tailings impoundment area would not be affected by tailings seepage. Under Alternative 3B, excess water with elevated nitrate concentrations would be mechanically treated and subsequently discharged to the Little Cherry Creek LAD area. Using this assumption, ground water in the Little Cherry Creek LAD area would be affected. Ground water in the Ramsey Creek LAD would be only minimally affected by discharge of "post-construction" adit water, expected to have quality similar to bedrock ground water. During the construction phase, land application would reduce significantly the concentrations in discharge water reaching ground water. Assuming 90 percent nitrate removal by mechanical treatment and 80 percent removal by subsequent land application, discharge waters reaching ground waters in the Little Cherry Creek LAD area during all project phases would have nitrate concentrations of less than 1 mg/L, under Alternatives 3A or 3B. Mixing with ambient ground water reduce concentrations further.

Under Alternative 3C, Noranda would prepare a comprehensive water management/water treatment plan and submit the plan to the agencies during final design for review and approval. Water management would include storage of excess water during the winter months and the discharge of excess water to LAD areas during the growing season. Additional LAD areas would be constructed in the tailings impoundment area. One possible water management/water treatment scenario is discussed in Chapter 2 under *Alternative 3–Option C*.

Ground water in the tailings impoundment area would be affected by both tailings seepage and excess water discharge. Ground water underlying two large potential LAD areas on the south side of the impoundment may discharge to Little Cherry Creek, Libby Creek, Poorman Creek, or unnamed tributaries to Libby Creek. Depending on the LAD areas used, changes in ground water quality may occur outside the permit area or mixing zone. Assuming 80 percent nitrate removal by land application, discharge waters reaching ground water would have a concentration between 4 mg/L and 16 mg/L, depending on the actual nitrate concentration of the discharged waters. A loading analysis of the projected impacts was not conducted because of the complexity of the ground water system (discussed in the *Surface Water Quality* section). Assuming a groundwater flow similar to that used in the Ramsey Creek LAD area, resulting ground water nitrate concentrations would be between about 2 mg/L and 8 mg/L. Ground water flow in the Little Cherry Creek LAD area may be less, however, resulting in increased nitrate concentrations.

Installation and sampling of additional monitoring wells would be required under Alternative 3C. Wells would be installed within and adjacent to the Little Cherry Creek LAD area. Wells would be sampled monthly during the first year of construction. The frequency of subsequent monitoring would depend on the first year's monitoring results and the actual nitrate and ammonia concentrations in the excess water. Mechanical treatment may be necessary if exceedances in ground water standards are detected during monitoring.

Under all options, an authorization by the Board of Health and Environmental Sciences probably would be required, allowing a change in nitrate concentration and total dissolved solids over ambient ground water quality. The uncertainty associated with metals concentrations would be similar to that described for Option A.

ALTERNATIVES 4, 5 AND 6

Ground water resources would not be affected by the proposed transmission line.

CUMULATIVE IMPACTS

No cumulative impacts to ground water quality in the project area would occur for any alternative. The impacts of the proposed project would be limited to the vicinity of the mine area, and to the Little Cherry Creek tailings impoundment site. No ground water effects would result from the projected timber sales. ASARCO's proposed Rock Creek project, which includes underground mining, would affect bedrock ground water systems west of Noranda's proposed operation. It is unlikely that the two operations would have any cumulative effects on ground water quantity.

RESOURCE COMMITMENTS

Water currently stored in joints and fractures above adits and mine workings would be drained and used in the milling process or discharged to ground water at the land application disposal areas. Following mining, water would continue to flow into the mine workings unless joints and fractures are grouted or the adit is plugged. Water levels in the mine would rise until surface discharge occurs along natural pathways or at the mine adits. Use of water stored in joints and fractures would be an irreversible commitment of resources.

Some existing springs and seeps would be covered by the tailings impoundment, but these might reemerge downgradient of the tailings embankments. Any loss of springs and seeps would be an irretrievable commitment of resources.

Under Alternatives 1 and 3, proposed discharges and tailings pond seepage would alter the water quality in the land application disposal area and tailings impoundment area, primarily by increasing the concentrations of total dissolved solids, metals and nutrients. It is unknown how long ground water quality adjacent to the land application disposal area would be affected after mining ceases. Increases would be less with water treatment systems proposed as an option in Alternative 3.

Ground water quality effects in the impoundment area would decrease following mining operations as impoundment seepage decreases. Some seepage from the impoundment would continue in perpetuity. The tailings are not anticipated to be acid generating, and the quality of the discharge would remain the same or improve with time. It is unknown how long ground water quality adjacent to the tailings impoundment area would be affected after mining ceases. Any permanent change in ground water quality in the LAD area and tailings impoundment areas would be an irreversible commitment of resources.

ALTERNATIVE 7

Under Alternative 7, the ground water impacts would not occur. Existing ground water characteristics, including recharge, flow paths, discharge, and water quality would remain as they are currently.

WETLANDS AND "WATERS OF THE UNITED STATES"

SUMMARY

Under Alternatives 1, 2, and 3, the Little Cherry Creek tailings impoundment would fill about 14 acres of wetlands and 5.8 acres of waters of the U.S. It is unknown if Noranda's proposed pressure relief/seepage collection system would affect wetlands downstream of the tailings impoundment.

Widening the existing Bear Creek access road would unavoidably fill and cause the direct loss of approximately 0.4 acre of herbaceous/shrub wetlands and less than 0.1 acre of waters of the U.S. Temporary indirect impacts to wetlands and waters of the U.S. would occur during construction due to increased sediment contributions to wetlands and waters of the U.S. Proposed best management practices would reduce sediment contributions to wetlands and waters of the U.S. No other mine facilities would affect wetlands or waters of the U.S.

Noranda has a proposed mitigation plan to create and expand wetlands. Suitable sites exist on- and off-site to develop new wetlands or to expand existing wetlands. Noranda's proposed wetlands monitoring plan would evaluate the success of the mitigation plan. Under Alternatives 2 and 3, the monitoring plan would be continued for a longer period.

Under Alternatives 2 and 3, additional wetlands would be replaced to mitigate for the uncertainty associated with parts of Noranda's proposal. Noranda also would implement additional fisheries mitigation to mitigate effects to Little Cherry Creek. Additional monitoring of wetlands downstream of the impoundment also would be conducted. No wetlands would be affected by Alternatives 4, 5, and 7. Alternative 6 would affect less than one acre of wetlands.

ALTERNATIVE 1

Impacts

Noranda has mapped wetlands at all mine-related facilities, at the Sedlak Park substation site and along the alternative transmission centerlines. Three types of wetlands occur—herbaceous, herbaceous/shrub, and forested. Wetlands and "waters of the U.S." would be adversely affected by constructing the tailings impoundment, and to a limited extent, by widening the Bear Creek access road and constructing the transmission line and substation.

Little Cherry Creek tailings impoundment. The Little Cherry Creek tailings impoundment would fill about 14 acres of wetlands and 5.8 acres of waters of the U.S. All three wetland types would be directly affected as follows—

- Herbaceous/shrub wetlands: 13.3 acres;
- Forested wetlands: 0.2 acre; and
- Herbaceous wetlands: 0.5 acre.

Indirect impacts to wetlands also may occur. Surface flow in Little Cherry Creek downstream of the diversion dam may cease during low flow periods. Wetlands in the area immediately adjacent to the Creek may be altered by a reduction in surface and ground water flows. Very small wetlands associated with springs and seeps downstream of the impoundment may also be altered by a reduction in ground water flows. Species more tolerant of drier sites might replace species requiring very moist soil conditions. Some research, however, has shown

that wetlands and riparian vegetation are supported by valley sideslope flow and ground water inflow. Such hydrologic support is not uncommon in subalpine and montane wetlands along streams (Ruddy and Williams, 1991). It is uncertain if reducing surface and ground water flows would affect the functions and values of wetlands downstream of the impoundment.

Temporary indirect impacts to wetlands and waters of the U.S. would occur during construction of the proposed tailings impoundment facility due to increased sediment contributions to wetlands and waters of the U.S. Proposed best management practices (BMPs) would reduce sediment contributions to wetlands and waters of the U.S. (see Appendix G for proposed BMPs).

Bear Creek access road. Widening the existing Bear Creek access road would unavoidably fill and cause the direct loss of approximately 0.4 acre of herbaceous/shrub wetlands and less than 0.1 acre of waters of the U.S. Indirect impacts to wetlands and waters of the U.S. would be temporary and would be associated with road construction potentially increasing sediment contributions to wetlands and streams. Proposed BMPs would reduce indirect impacts.

Noranda's Wetlands Mitigation Plan

Noranda's wetland/fisheries mitigation plan includes the creation and enhancement of wetlands to replace those destroyed or degraded by the project, and fisheries improvements in Howard and Midas creeks to compensate for effects to Little Cherry Creek.

Noranda's proposed wetlands mitigation is based on a one-for-one acreage replacement of wetlands destroyed or degraded by the project, and replacement of existing wetland functions and values as closely as possible. Noranda would create approximately 14.4 acres of wetlands to replace those directly affected by the tailings impoundment and Bear Creek access road. The main functions of the existing wetlands are wildlife habitat and, to a lesser degree, as erosion control and removal of suspended sediments. The principal values of these wetlands include habitat diversity and aesthetics. The agencies agree that a one-for-one acreage replacement is adequate mitigation for the functions and values provided by the herbaceous/shrub wetlands that would be affected adversely (13.7 acres). These types of wetlands would be capable of being replaced and functioning within a relatively short time period (2 to 5 years after construction). The more difficult to replace functions and values are those provided by the forested wetlands (0.2 acres) and the herbaceous wetlands (0.5 acres). The agencies believe a 2:1 replacement ratio is more appropriate for these wetlands based on the possibility that developing wetlands to provide the same function and values would be more difficult, and that additional time would be required for their establishment (see following discussion under Alternatives 2 and 3). Following is the agencies analysis of Noranda's mitigation plan.

Noranda has identified approximately 44.6 acres of possible wetland mitigation at eight separate sites (see Figure 2-21 in Chapter 2). All of these sites are in the immediate vicinity of the project. Those within the proposed permit boundary are considered on-site; those outside are off-site. Noranda has prepared conceptual engineering drawings for most of these sites, and has collected some hydrologic and soils data in the area. Noranda has not, however, conducted the detailed site-specific investigations necessary to determine specifically what problems might be encountered in creating or enhancing wetlands, and what level of maintenance might be required to maintain the wetland. Noranda proposes to collect more detailed site-specific information during final design and site selection.

Noranda has conducted additional analysis relative to the hydrologic status of each proposed wetland site. A detailed water balance for each site was developed using expected evaporation, precipitation, runoff, seepage and other hydrologic characteristics. Noranda anticipates sufficient surface water and

shallow ground water would be available to support wetland vegetation. In the event that monitoring indicates insufficient moisture, artesian wells would be completed and flows from the wells directed to certain wetland sites.

Despite the lack of detailed site data, the agencies believe adequate information exists to assess the probability of success in developing replacement wetlands, and to disclose the likely effects. This assessment is based on the occurrence of existing wetlands in the area, and their similarity to soils and hydrologic conditions in proposed wetland mitigation areas. Some of these existing wetlands appear to be caused by logging and road building activities, thereby demonstrating the potential for creation of additional sites.

Creation or expansion of any of the wetland sites could affect timber productivity. Any timber currently at the sites would likely either be removed or would die as site conditions are changed. Timber growing after creation or enhancement of wetlands might also be removed to ensure that wetland conditions are maintained.

Of those sites proposed by Noranda, the best are those adjacent to existing wetlands. The existence of these wetlands indicates the area generally has the hydrologic and soil conditions needed to develop a successful wetland. These include the North and South Poorman sites, the smaller Little Cherry Creek site, and the Ramsey Creek site. Approximately 22 acres of wetlands could potentially be developed at these sites. Of these, the 9.7 acre South Poorman site has the best potential. Adequate water appears to be available, and past logging and road-building activity in this area has already led to development of new wetland habitat. In addition, artesian ground water is present in this area and could be developed, if needed.

The Ramsey Creek site is adjacent to the proposed land application disposal areas. A small human-made wetland area already exists at the site. It is fed by a stream that could be spread out over a larger area to increase the size of the wetland. It is also adjacent to and downstream of an artesian well that could supply water to the site. Because it would be developed by a significant stream channel, the potential for excess water exists at this site. Any design would have to ensure that dikes or other barriers used to trap or slow waters would remain stable and not be subject to continuing maintenance.

The smaller of the two Little Cherry Creek sites has a small existing shrub-dominated wetland. Noranda proposes to use surface water and ground water from selected pressure relief/seepage collection wells to enhance this wetland and increase its size. It is uncertain at this time whether the water would be of acceptable quality.

It is doubtful whether Noranda's proposed design of the Little Cherry Creek diversion dam and channel would provide functions and values similar to a conifer dominated riparian zone, as suggested by Noranda. Further, Noranda's plan does not include mitigation for the pool and riffle habitat found in Little Cherry Creek.

The Poorman Weather Station site is in an area of fine-grained lacustrine soils. The area already receives significant wildlife use, as evidenced by the presence of numerous salt licks. This site does not have any well defined drainage, but ground water is believed to be close to the surface. Artesian ground water conditions exist in this area, and might be used as a supplemental water source. Noranda would excavate several small ponds in this area to intercept ground water and trap surface waters. Favorable soils occur in this area to retain water but it is uncertain, based on available data, if adequate water could be developed to maintain a wetland at this site.

The larger Little Cherry Creek site (5 acres) has been proposed but not specifically identified by Noranda. Noranda's intention would be to route up to 30 gallons per minute from selected pressure relief wells into low gradient constructed channels and allow water to flow and collect in a series of depressions. These channels and depressions would be located in

the drainage below the tailings impoundment. Based on area topography and the existence of wetlands in this area, it is likely that some sustainable wetlands could be created as proposed. As with the other Little Cherry Creek site, however, water quality from the pressure relief wells would be important in determining the suitability of this site.

The agencies do not favor creating a site at the Libby Creek Recreation Gold Panning Area. The area has cultural values associated with past mining activities that could be disturbed or diminished through creation of a wetland. Also, one of the functions of existing wetlands to be replaced is wildlife habitat. Although recreation use and wildlife habitat are not necessarily incompatible, the agencies believe it best not to mix these two uses as part of the wetlands mitigation plan.

The agencies believe that Noranda's proposed wetland monitoring program presented in Chapter 3 proposes adequate methods to determine the effectiveness of newly created or expanded wetlands, but does not cover a long enough time period for monitoring. Noranda's plan does not provide for monitoring of wetland areas downstream of the impoundment that might be indirectly affected by the project. Thus, additional wetlands that might be affected by the project would not be identified or replaced. Noranda's plan does provide an adequate contingency strategy (an interagency committee) to address remedial measures or to specify additional mitigation measures in the event that wetlands mitigation does not progress as planned.

Fisheries mitigation is discussed in greater detail in the *Fish and Other Aquatic Life* section. Fisheries enhancement of Howard Creek would consist of excavating organic material and fine sediment from the stream channel and replacing it with gravel suitable for trout spawning. This mitigation would result in the placing of dredged or fill material in the waters of the U.S., activities regulated under Section 404 of the Clean Water Act. Other wetlands may be affected to provide access to Howard Creek. Placing gravels in Howard Creek should provide better spawning habitat than the creek's current substrate. Additional mitigation may be necessary if wetlands would be affected permanently during mitigation implementation.

ALTERNATIVES 2 AND 3

Alternatives 2 and 3 would affect the amount of wetlands as described under Alternative 1. As described in Chapter 2, Alternatives 2 and 3 would require some changes to Noranda's proposed wetland mitigation plan. These include additional acreage at a 2:1 replacement rate to mitigate for existing forested and herbaceous wetlands affected by the diversion channel or access road. The 5.9 acres of the waters of the U.S. would be replaced on a 1:1 basis. This increased mitigation requirement addresses the uncertainty associated with Noranda's plans to reestablish the functions and values of the forested and herbaceous wetlands as well as Noranda's plans to reestablish wetlands in the Little Cherry Creek diversion channel. The 1:1 replacement for the 5.9 acres of affected waters of the U.S. would be out-of-kind mitigation. Herbaceous/shrub wetlands would be replaced on a 1:1 basis, as proposed by Noranda.

In addition, Alternatives 2 and 3 would include extending the proposed time period for monitoring the status of created wetlands, and developing a monitoring plan to assess potential indirect impacts to wetlands downstream of the tailings impoundment, with a commitment to replace any such affected wetlands. These measures would ensure that wetland effects are adequately identified and replaced.

The mitigation proposed by the agencies for the loss of fisheries habitat in Little Cherry Creek would result in the placing of dredged or fill material in the waters of the U.S., activities regulated under Section 404 of the Clean Water Act. The mitigation proposed would not have a significant adverse effect on the waters of the U.S., but would improve the aquatic habitat provided by area streams.

The agencies' modifications which are part of Alternative 2 and 3 also include monitoring of wetlands downstream of the tailings impoundment. Monitoring would ensure that significant changes in wetlands functions and values do not occur as a result of the tailings impoundment construction and operation. If significant changes occur, Noranda would develop additional wetlands mitigation.

IMPACTS COMMON TO ALL TRANSMISSION LINE ALTERNATIVES

Rerouting Sedlak Creek would place fill material in portions of Sedlak Creek, considered "waters of the U.S." No wetlands would be affected. Construction activities in Sedlak Creek might introduce sediment into Sedlak Creek and the Fisher River. Appendix H contains measures DNRC identified to minimize sedimentation impacts at Sedlak Park. These measures would be incorporated into DNRC's Environmental Specifications. The intermittent drainages crossed by the proposed transmission line routes also are considered waters of the U.S., but could be spanned by locating tower sites on upland areas above drainage bottoms.

The west bank of the Fisher River contains wet, low-lying areas created by floodplain scouring and sediment deposition during flooding and channel migration. This area is a cottonwood-conifer-dominated type of forested wetland. Cottonwoods are thought to require scoured bars of recently deposited alluvium for seed germination and growth (Johnson et al., 1976; Fenner, 1985). The Fisher River is the only riparian zone affected by the transmission line that contains this type of wetland. Except for Alternative 6, these wet areas can be avoided by slight adjustments in the centerline location.

A large shrub-dominated wetland is located 1/4 mile north of Howard Lake, adjacent to USFS Road 231. In time, the surrounding forest may overtake the shrub-dominated vegetation. A potential tower site is located south of the road within this wetland. The DNRC and the KNF would require that the tower be placed north of the road. Such placement would allow the wetland to be spanned.

The proposed tower near the confluence of Howard and Libby creeks would be located on a dry roadbed. This tower site is common to all alternatives. The roadbed is in a beaver pond complex with many flowing channels and ground water just below ground surface. Beaver activity keeps this area in a shrub-dominated stage. The DNRC and the KNF would require that the area be avoided by placing a tower on the knob east of the proposed tower site. A realignment of the centerline to another but less desirable location was considered to avoid the wetland, but such placement would put a tower within the Libby Creek floodplain.

ALTERNATIVE 4

In addition to the areas common to Alternatives 4, 5 and 6, this alternative would cross five intermittent streams with new access roads, but potential impacts would be minimized by adherence to Best Management Practices proposed by the agencies and Noranda.

ALTERNATIVE 5

The proposed North Miller alternative could avoid the cottonwood/conifer forested wetland along the Fisher River and the shrub-dominated wetland area near Howard Lake through tower placement that would allow these areas to be spanned. It would have the same tower site near Howard and Libby creeks as Alternative 4. No other areas of jurisdictional wetlands were identified along this route. Five intermittent streams would be crossed by new access roads. Application of the proposed Best Management Practices would minimize potential erosion and sedimentation in these areas.

ALTERNATIVE 6

The Swamp Creek route would cross the Fisher River approximately 1 mile north of the other two

alternatives, near an oxbow with standing water. This area is a cottonwood/conifer forested wetland and would not be avoided completely by construction activities. West of this oxbow is an old logging road that could be used for construction access. A realignment of the centerline would avoid the oxbow, but the areas upstream and downstream show evidence of past channel movement. The river has been channelized to help protect a house downstream. Still, the active nature of the river in the area would make tower placement difficult and increase the cost of constructing in this location. Some filling of wetland areas would be required for access and individual tower locations. Removal of cottonwood and conifers located in the wetland also would occur.

This alternative shares the same tower location near the confluence of Libby and Howard creeks as described for Alternatives 4 and 5 and the same mitigation measures would be required.

CUMULATIVE IMPACTS

The cumulative impacts of all alternatives are similar. The ASARCO Rock Creek Project, the Montanore Project, projected timber sales in the Montanore Project area, and the U.S. 2 reconstruction may affect wetlands and waters of the United States. The effects, however, would require mitigation in accordance with the federal wetland mitigation policy.

RESOURCE COMMITMENTS

Construction of the tailings impoundment would destroy about 14 acres of wetlands and fill 5.8 acres of waters of the U.S. Less than 1 acre of wetlands or waters of U.S. would be filled by access road construction. The waters of U.S. would be irreversibly filled. Proposed wetlands mitigation plan, if successful, would replace the function and values of the destroyed wetlands. Alternatives 2 and 3 would include additional wetlands mitigation to mitigate for the affected waters of the U.S.

ALTERNATIVE 7

Wetland resources and waters of the U.S. would not be affected under Alternative 7.

FISH AND OTHER AQUATIC LIFE

SUMMARY

Project area streams are typically low in bedload fine sediment. This is partly the result of high stream flows. The proposed project would result in slight increases in sediment loads and turbidity downstream of the proposed project. Under all action alternatives, impacts to fish and other aquatic life from increased sedimentation would be insignificant—to some extent, a limited increase in sediment to the streambed might actually benefit aquatic life at some locations.

The proposed diversion of Little Cherry Creek and placement of the tailings pond in Little Cherry Creek is estimated to cause a loss of 330 "cuttbow" trout. In addition, the project may affect other populations and habitat of these species due to the release of small gravels or fine sediments from the project area, if such releases are excessive beyond those typically occurring when best management practices to control sediments are implemented adequately.

Alternatives 1 and 2 would result in increased concentrations of minerals and nutrients, which would increase the productivity of many aquatic populations. Nutrients are projected to exceed

aquatic life standards based on certain assumptions in the agencies' analysis. Increased algal growth could affect aquatic life adversely, particularly during periods of low flow. Not much is known about the effects of slightly increased metals concentrations on organisms inhabiting very soft waters, such as in the Libby Creek drainage. Baseline metals concentrations indicate some potential risk to aquatic populations, but the extent of risk is not known. Noranda's proposed discharge would increase metals concentrations in Libby and Ramsey creeks.

Under Alternatives 3A and 3B, some or all excess water would be treated with a mechanical system, reducing nutrient and metals concentrations in receiving streams. Secondary treatment would reduce nitrogen concentration at or below which may produce undesirable conditions for aquatic life. Noranda would implement an expanded monitoring program under Alternatives 2 and 3 to evaluate impacts to fish and other aquatic life. Using a high range of nitrate and ammonia concentrations in the analysis, projected concentrations of nitrogen under Alternative 3C during Year 3 would exceed those which may result in growth of undesirable aquatic life. Noranda would conduct additional monitoring and change its operating plans, if necessary, to ensure protection of fish and other aquatic life.

Changes in transmission line construction methods in Alternatives 4, 5, and 6 would slightly reduce the amount of sediment reaching the Fisher River and Ramsey Creek compared to Alternative 1. Existing conditions would be maintained with Alternative 7.

ALTERNATIVE 1

Potential impacts to fish and other aquatic life in the Libby Creek drainage from the proposed Montanore Project can be grouped under five general concerns: sediment, water quantity, water quality, toxic metals, fish passage, and effects on threatened, endangered or sensitive species.

Sediment

Projected increases in bedload fine sediment and turbidity downstream from the proposed project would be small because most of the facilities (e.g., mill, adits, tailings pond) would include containment features that route all water and sediment to sediment or collection ponds. Road reconstruction would include use of gravel and asphalt surfaces through parts of the project area. Transmission line construction would result in minimal increases in fine sediment due to construction methods and best management practices. Also, KNF Best Management Practices would be used to reduce the amount of sediment reaching streams (see Appendix G for proposed BMPs).

The planned diversion of runoff from the reclaimed tailings impoundment would discharge runoff water as uncontrolled flow down a hillslope into Bear Creek. Gullying of the hillslope and sediment erosion may occur, which would be at least partly mitigated by using a check dam to reduce sediment flow into Bear Creek.

Noranda does not plan to provide erosion protection for the natural stream channel downstream of the Little Cherry Creek diversion channel because the channel is heavily timbered. It is unlikely, however, that the natural channel would provide adequate protection. If it is insufficient, gullying of the channel would occur, and excess sediment would be delivered to Libby Creek. The amount of sediment that would enter Bear Creek or Libby Creek accompanying major surface runoff events from the impoundment and failure of the check dam cannot be projected. If a substantial quantity of sediment enters these creeks, significant adverse short-term and/or

long-term impacts may affect downstream aquatic life in these creeks.

A permanent diversion of Sedlak Creek around the proposed transmission line substation would be necessary. The diversion would introduce some sediment into Sedlak Creek. The sediment would have no measurable effect because fish are absent in the creek.

Sediments less than 1/4 inch in diameter are generally assumed to have adverse effects on fish and other aquatic life when they are at excessive levels in-stream, or when they are added to a stream system where fine sediment limits fish production. The duration of exposure to suspended sediment is as important as the concentration, but at this time it is not possible to predict effects on aquatic life because of other mitigating circumstances (Newcombe and MacDonald, 1991). In Libby Creek, these generalizations, and similar laboratory studies, do not work well due to the scarcity of these finer materials in fish habitat as a result of natural and human causes. New additions of small gravels and fine sediments would have few if any effects in Libby Creek, since the abundance of small and fine sediments is not a limiting factor on the maximum productivity of fish and other aquatic life in Libby Creek and its tributaries. Increases in small and fine sediments may improve habitat stability, which is believed to be a limiting factor in stream segments severely affected by occasional rain-on-snow bedload events.

Three environmental characteristics of the Libby Creek drainage system also limit the long-term potential for adverse impacts to bull trout and other aquatic life from increased sediment. First, streams in the project area frequently have violent high flows that accompany early-winter or spring rain-on-snow events. These intense flows, combined with a lack of natural sediment traps, such as pools and woody debris, restrict accumulations of smaller gravel and finer sediment in area streams. As a result of these flow conditions, most of the sediment entering the upper Libby Creek drainage from the proposed project would either disappear deep into the underlying streambed of tributaries and not affect fish and other aquatic life, be carried downstream and deposited in floodplains and low gradient stream reaches, or be transported to the Kootenai River.

Second, both fish and stream invertebrates are strongly affected by the character and condition of the streambed. Gravels (1/4- to 2-inch diameter) provide important habitat for fish spawning and both gravel and smaller-sized particles (less than 1/4-inch diameter) can provide important habitat for propagation of aquatic insects (Everest et al., 1987). These materials are generally scarce in Libby Creek and in the downstream reaches of most tributaries that drain the proposed project. Increasing the availability of both materials in area streams may benefit resident fish and aquatic invertebrates in two ways—

- Additional smaller gravel may increase the availability of sites having spawning habitat. This might increase reproductive success by fish populations in years when spawning habitat is limited (Reiser and Bjornn, 1979).
- Stream invertebrates are strongly affected by the character and conditions in a streambed, as are the fish to some degree. Additional finer sediment may help to increase invertebrate productivity or diversity and thereby enhance the food supplies for some age classes of fish (Chapman and McLeod, 1987).

These changes in streambed sediment also may increase fish productivity (Reiser et al., 1987), which add to productivity increases that are believed to accompany changes in water quality hardness (see preceding *Surface Water Quality* section).

Natural floods, a catastrophic fire in 1910, and the destructive effects of historical gold mining cause many stream reaches in the Libby Creek drainage to be unstable and unproductive. When small particles in a streambed are removed, the larger particles are more easily displaced by erosive flow (Petit, 1988). The arrangement, mix, and shapes of rock particles in a streambed define the stability of its channel (Komar and Li, 1986; Laronne and Carson, 1976;

Leopold and Emmett, 1981). The stability of the lower reaches of Poorman Creek and Ramsey Creek, and the upper and lower reaches of Libby Creek may improve slightly due to additions of both smaller gravel and finer sediment. These materials may eventually help to stabilize the streambed substrate and help reduce the severity of periodic intensive flows and downstream loss of fish and fish-food organisms during times of flood flows (Reiser et al., 1985; Reid and Frostick, 1984).

Catastrophic failures of the tailings or sediment ponds are considered low probability events. Should such a failure occur, however, large masses of sediment would flush into the stream channel and cause extensive adverse impacts to aquatic life. Portions of this sediment mass probably would remain within the Libby Creek channel for an undefined period following the failure, while the rest would be carried downstream out of the Libby Creek system. Relative proportions of standard transported sediment would depend on the volume of water associated with the failure, and the initial volume and character of the sediments.

Subsequent to any such failure, normal high-volume, seasonal flushing flows would continue to wash most of the remaining sediment downstream, out of the Libby Creek system and into the Kootenai River. Consequently, most fine sediments from any such catastrophic failure would not be expected to persist within Libby Creek beyond a few years. Typically, following catastrophic events and depending on season, algae populations begin natural recolonization of affected stream reaches within a few days, larger plants within a few weeks, and many aquatic invertebrates within a few months to a year. Fish populations should naturally return to former population numbers within a few years.

Water Quantity

Streamflow volumes would increase as waters from the land application disposal areas and tailings impoundment seep into ground water and ultimately discharge into Libby Creek (Table 4-8). During periods of high flows, these increases would not affect fisheries or the aquatic environment significantly. During periods of average to low flows, such increases may augment streamflows by as much as seven percent, potentially increasing the availability of habitat suitable for aquatic life. This increase may increase productivity and reproductive potentials for aquatic populations at these times.

Noranda has indicated direct surface water withdrawals would occur only as a last resort. Because surface water withdrawals are not anticipated, timing of withdrawals has not been specified. Such withdrawals could have negative effects if they occurred during low flow conditions.

Water Quality–Nutrients

The surface waters of the Libby Creek drainage have low concentrations for most dissolved constituents (metals and nutrients). As discussed in Chapter 3, the extremely low nutrient concentrations severely limit productivity and produce marginal habitat conditions for fish and other aquatic life.

Accompanying the potential increased volume of water entering streams in the Libby Creek drainage, water quality estimates project an increase in concentrations of all dissolved constituents (see *Surface Water Quality* section). The projected increases in many minerals (e.g., calcium, potassium, etc.) probably would increase the productivity of the aquatic community and growth rates for fish. Since only slight increases are projected for most dissolved constituents, their influence in increasing productivity also are expected to be minimal.

In contrast, dissolved concentrations for total nitrogen (nitrates, nitrites, and ammonia) are projected by the agencies to increase substantially over background concentrations (from <0.2 mg/L to about 8 mg/L in Libby Creek to about 28 mg/L in Ramsey Creek; see Tables 4-14 through 4-16), during periods of low flow. Total inorganic nitrogen

concentrations greater than 0.5 mg/L are often associated with eutrophic conditions, and greater than 1.5 mg/L with hypereutrophic (very high productivity) conditions (Wetzel, 1975).

While dissolved phosphorus concentrations in area streams have not been modelled, average concentrations of phosphate in Libby Creek adit water were 0.24 mg/L for ortho-phosphate, and 0.7 mg/L for total phosphate (Noranda Minerals Corp., 1992a). Noranda's water quality monitoring data indicates that total phosphorus concentrations ranged between <0.005 mg/L and 0.010 mg/L at monitoring stations up- and downstream of the adit. Dissolved concentrations of total phosphorus greater than 0.03 mg/L can be associated with eutrophic conditions (Wetzel, 1975). In addition, DHES analyses of algal samples collected in Libby Creek near the area of this discharge revealed the algal growth to be dominated by a species that is "an indicator of heavy nitrogen loading and eutrophication... typically found in large numbers in wastewater treatment lagoons in the final stage of treatment" (L. Bahls, 12/15/91 memorandum to Tom Reid, DHES, accompanying 12/11/91 field report).

The presence of this algal growth downstream of the adit indicated that phosphorus was not immediately limiting algal growth and phosphorus must be entering the stream with discharged adit waters. Noranda's 1991 aquatic monitoring data show that algal biomass is increasing downstream of the adit. Species of algae and aquatic insects inhabiting this site showed a general trend of shifting from species being most sensitive of environmental changes (including increased nutrient loadings) to those being more tolerant of such changes. In particular, growths of blue-green algae appeared to have greater densities at the site immediately downstream of the adit discharge than at any other sampling location.

Phosphorus can be removed from aquatic systems in less than a minute by aquatic microorganisms after it becomes available (Cole 1979). It also can be recycled among these organisms at equally rapid rates. Consequently, these very rapid uptake and recycling rates can cause considerable difficulty in the ability to measure biologically available phosphorus in aquatic systems. This produces additional difficulty in simply evaluating its importance in enhancing the productivity in the Libby Creek system. That is, while it often may not be possible to detect measurable biologically available phosphorus in the water column, the rapid initial uptake rate and the mass of phosphorus recycled among the biota can lead to extensive growths of algae.

Based on (1) projected nitrogen discharges, (2) concentrations of phosphorus in adit waters, and (3) growths of eutrophic forms of algae downstream of existing discharges, it appears very likely that discharge of excess waters in the quantity projected from the proposed project would lead to a significant increase in algal growth and eutrophication through a substantial reach of Libby Creek downstream from the project area. It is also possible, however, that growth limitations attributable to nutrients other than nitrogen or phosphorus could become limiting to algal growth in stream reaches nearest the mine. If this occurs, then excess nitrogen and phosphorus draining from the project area likely would be available to enhance algal growth in downstream reaches, wherever the limiting element become less limiting. If only mild eutrophication accompanies the discharges, this could stimulate productivity rates for aquatic insects and, consequently, for trout and other fish populations. If hypereutrophic conditions develop, the character of the aquatic insect community would likely change to species less suitable or desirable as food for trout, which could then adversely affect fish life in Libby Creek. If extremely hypereutrophic conditions develop, it is possible during some very warm, low-water years that algal toxins produced by blue green algae which are lethal to fish and other aquatic life, could be released during late summer or early fall. Downstream fish kills might result.

Additionally, any massive increase in the production of algae associated with hypereutrophic conditions

might produce intermittent periods of low dissolved oxygen concentrations in Libby Creek. Such times may include low-water, over-night periods when dark respiration by the possibly high population densities of algae produce high demands on dissolved oxygen. In extreme cases, oxygen concentrations might be significantly depressed or depleted. Also, in late fall when algae mats die and decompose, a high oxygen demand and low dissolved oxygen levels can result. In the Libby Creek system, such problems would have their highest probability of occurring in pools during low flows in late summer or winter. Pool bottoms provide trout with important cover to hide from predators during the summer and to escape the warmer water temperatures. During winter months, channel widths are often constricted due to ice formations that grow from the bank toward the center of the channel. This has the effect of increasing flow velocity in the center of the channel. At these times, pools become critical habitat for trout in escaping these higher velocity flows. Pools also can provide trout with cover from problems arising from anchor ice formation. If extensive growths of the algae do result from the Montanore Project, any low dissolved oxygen conditions that might accompany these growths might also produce a possible source of stress or mortality to fish and other aquatic species inhabiting Libby, Poorman, or Ramsey creeks.

Water Quality–Metals

Dissolved concentrations of various heavy metals are projected to increase slightly in Ramsey Creek and Libby Creek during mining (see *Surface Water Quality* section). The potential for impact, however, on the aquatic community accompanying any increases in heavy metals concentrations is unclear. Water quality standards (those discussed in the Table 4-13) for cadmium, chromium, copper, lead, silver, and zinc are calculated using EPA equations (EPA, 1986). Aquatic life standards are designed to protect fish and other aquatic life. The environmental effect of metals on fish is directly related to water hardness. Generally as hardness decreases, environmental effect of metals increases, so standards decrease.

The EPA equations used to calculate standards, however, do not reliably predict potential environmental effects (such as chronic toxicity) of these metals in extremely soft waters, such as those in the Libby Creek drainage. For example, Montana surface water quality standards for aquatic life use 20 mg $CaCO_3$/L hardness to calculate metals standards in soft waters (<20 mg $CaCO_3$/L). Water hardness measured in samples from Libby Creek and its tributary streams, however, is often less than 10 mg $CaCO_3$/L. Since the water hardness in project area streams is generally less than 20 mg $CaCO_3$/L and the validity of the EPA equations at water hardnesses of 20 mg $CaCO_3$/L or less is uncertain, the concentrations of these metals that would cause toxicity in these streams are unknown. Also, there is little scientific basis for assessing the potential for additive toxicity among these metals in very soft waters.

The low concentrations of dissolved minerals in surface waters of the Libby Creek drainage cause these waters to tend toward acidic pH levels, and to have extreme sensitivities to fluctuations in acidity. For most heavy metals, the percentage of the metal occurring in the dissolved form increases with increasing acidity. Dissolved metals generally have the greatest potential toxicities and effects on fish and other aquatic organisms. Without a better approach, the EPA equations suggest that existing water quality conditions pose high potential risks to the aquatic life presently inhabiting these streams. The presence of diverse size classes of fish in area streams, however, suggests that toxicity is not currently controlling these populations. It is not known whether chronic metal toxicity might be contributing to the low population densities in these streams. The projected increases in dissolved concentrations of heavy metals accompanying the Montanore Project could increase the potential risk for future impacts to fish and other aquatic life. If the projected metal concentrations exceed toxic concentrations, fish in affected streams

may incur physiological stress, such as respiratory and ion-regulatory stress, and may die.

Predicting potential impacts to fish and other aquatic life in the Libby Creek watershed is significantly complicated by the fact that the very low dissolved hardness and alkalinity concentrations occurring in these waters naturally cause ion-regulatory difficulties and stress in fish. These problems are exacerbated by the low nutrient and productivity levels in the streams that permit only minimal production of food organisms for fish, causing additional stress to fish and other aquatic life. Impact projections are also complicated by the fact that resident fish can successfully acclimate and adapt to various stressful water quality conditions, including softwater and the presence of toxic metals (Sprague, 1985).

With mining, not only would the concentrations of some potentially toxic metals likely increase, which can increase stress to aquatic life, but hardnesses, alkalinities, and biological productivities in the streams would also likely increase, which can help decrease stress to aquatic life. Neither laboratory nor field simulation studies can adequately mimic or model the ranges and combinations of water quality conditions that would occur in these streams during the life of the mine. Nor can such studies incorporate the range of possible adaptation, acclimation, and behavior modifications occurring within aquatic life to potential changes in toxic metal concentrations. The only accurate way to evaluate effects on fish and other aquatic life in these waters is to monitor for changes in instream aquatic life before, during, and after mine operations. Results from monitoring studies can then be used to guide any necessary changes in mine operations. The agencies' proposed monitoring plan, designed specifically to address these issues, is presented in Appendix B.

Toxic Metals in Fish

Baseline study results show low concentrations of zinc, cobalt, copper, lead, and mercury occur in the fish of Libby Creek. Since zinc, cobalt, and copper are essential human nutrients and human consumption of fish from these streams is low, human health risks are probably low. As noted in the previous section, it is unknown whether fish are currently being affected by metal toxicity in these streams.

The concentrations of mercury and lead found in fish from these waters does signify a need for continuing concern. Both elements can pose significant health risks to humans. Based on FDA standards, mercury concentrations in fish flesh for human consumption may not exceed one microgram per gram. There is presently no standard for lead. Mercury concentrations found in the sampled fish average approximately 20 percent of the FDA regulation, indicating there is no present risk. If mining increases concentrations of either metal in surface waters, they might also increase in fish tissues suggesting an increased risk for potential impacts to fish and other aquatic life, and an increased risk to human consumers of these fish.

Fish Passage and Unmitigated Losses

Proposed road construction between U.S. 2 and the proposed plant site would include stream crossings on Bear, Little Cherry, and Poorman creeks. Noranda's proposed Best Management Practices, if appropriately implemented, would minimize effects to fish passage.

The mine plan also calls for constructing a permanent diversion of Little Cherry Creek around the tailings impoundment into an unnamed tributary to Libby Creek. Within the diversion channel, a secondary channel would be constructed. The active channel would be designed to contain the average annual high flow. The channel foundation would be lined with compacted silty clay/clay in an attempt to perch the flow above the design flood diversion riprap. Steep sections of the channel would consist of a series of structures that would provide energy dissipation in the event of high flows. The channel may allow

successful fish migration depending on flow conditions. Fish passage would be restricted during low flow conditions.

The diversion channel would provide, at best, minimal habitat for fisheries in the downstream reaches. There would be no typical habitat components, such as woody debris, meanders, undercut banks, or overhanging vegetation. In addition, the proposed pressure relief well system to pump ground water from under the tailings impoundment would reduce water flow into the original Little Cherry Creek drainage. These factors would combine to degrade and eliminate fisheries habitat over 5,500 feet in the downstream reach of Little Cherry Creek. Baseline studies indicated that Little Cherry Creek had the greatest trout densities of the streams associated with the project, ranging from none to 11.8 fish per 100 square feet of channel. An estimated 330 fish would be displaced (lost) annually with the proposed diversion.

Threatened, Endangered, or Sensitive Species

The Montanore Project may adversely affect bull trout and their habitat in the Libby Creek stream system. Some short-term and, possibly, long-term impacts may result from increases in in-stream concentrations of nutrients and toxic metals, possible bioaccumulation of toxic heavy metals, and potential blockage of fish passage.

There is a metapopulation (several small tributary populations that inter-breed) of hybridized redbands in Libby Creek. Under interim guidelines adopted by the Kootenai National Forest as a consequence of this project, these Libby Creek hybrid "cuttbows" qualify as an Experimental Redband Population (R.L. Schrenk, KNF memo, 1992). This designation affords special conservation protection to the metapopulation, but acknowledges that the species is hybridized and in need of restoration work. Impacts to Little Cherry Creek and other tributaries would reduce the abundance of these "cuttbows" in general, and under certain environmental conditions, could result in a catastrophic fishkill.

The proposed diversion of Little Cherry Creek and placement of the tailings pond in Little Cherry Creek is estimated to cause a loss of 330 "cuttbow" trout. In addition, the project may affect other populations and habitat of these species due to the release of small gravels or fine sediments from the project area, if such releases are excessive beyond those typically occurring when best management practices to control sediments are implemented adequately.

The potential cumulative effect of these individual impacts also would decrease the potential for restoring interior redband trout populations in the Libby Creek system.

Accurate predictions of possible impacts to on-site trout, sculpin and whitefish populations is difficult due to the generally poor understanding about fishery-habitat relationships in waters having naturally very low dissolved concentrations and bioavailabilities of most nutrients and other minerals required for maintaining the life of aquatic organisms. Bull trout populations downstream of the project area probably would not be affected by the proposed project. Similarly, populations of torrent sculpins inhabiting downstream reaches of Libby Creek, near U.S. 2 and at the old hatchery in Libby, would not be adversely affected.

Special concern exists about potential release of metals and sediments from the Montanore Project potentially affecting populations of white sturgeon in the Kootenai River and affecting downstream efforts of Native American culture of this species. But the Montanore Project would not likely have adverse affects on white sturgeon population or its habitat in the Kootenai River. Proposed erosion and sediment controls, and best management practices would minimize potential release of sediments from the project area.

The *Surface Water Quality* section also indicates that during low flow conditions in the Kootenai River, projected maximum discharges from the project

would contribute less than 0.05 percent of the flow and about 0.7 percent of the total chemical loading (for manganese as an example) in the Kootenai River. Such increases would likely be undetectable. In addition, since the alkalinity and hardness of the Kootenai River often are nearly 100 times greater than those found in Libby Creek, any metals entering the Kootenai River from the project would tend to have very low bioavailabilities. Finally, recent findings by the Idaho Fish and Game Department indicates that metals or other contaminants do not appear to be the cause of declining sturgeon populations in the Kootenai River (M. Marcus, 3/19/91 memo). Thus, discharges from the project have a very low probability of impacting white sturgeon populations or their culture efforts in Idaho.

Additional discussion about potential impacts to sensitive species are contained in the *Biological Evaluation for Fish* for the Montanore Project, on file at the KNF office in Libby, MT.

Tribal Treaty Rights

The Hellgate Treaty of 1855 reserved for the Kootenai Nation, among other rights, "the right to fish at all usual and accustomed places...[and] the privilege of hunting, gathering roots and berries...on open and unclaimed lands". Based on the agencies' analysis, elevated concentrations of nitrogen compounds (ammonia and nitrate) would adversely affect fish and other aquatic life in Ramsey and Libby creeks under Alternatives 1 and 2. Under Alternative 3, nitrogen concentrations in all area creeks would below concentrations designed to protect fish and other aquatic life. The quality of fishing in these creeks would be reduced. No significant effects are anticipated to white sturgeon in the Kootenai River. No effects on tribal fishing rights in the Kootenai River as a result of the project would occur.

Noranda's Mitigation Plan

Noranda's fisheries mitigation plan consists of two components—

- creating spawning habitat in Howard Creek; and
- introducing spawning fisheries in Midas Creek.

Noranda's plan would improve fisheries habitat in Howard Creek and increase fish spawning in Midas Creek. Fish passage in Midas Creek, however, may be limited by a natural falls and a culvert at the Midas Creek Road crossing. Noranda's proposal to introduce spawning fish in Midas Creek may not be successful without improving fish passage, and would be undesirable unless restoration work on the hybrid fish in Midas Creek is completed. Noranda would also conduct most of the monitoring recommended by the agencies in Alternative 2. Potential losses of bull trout, and restoration of the hybridized redband trout in Libby Creek, would not be mitigated under Noranda's proposal.

ALTERNATIVE 2

The effects on water quality, and fish and other aquatic life, would be the same for Alternative 2 as those described for Alternative 1. Alternative 2 would increased monitoring of fish and other aquatic life. The agencies' proposed monitoring plan is presented in Appendix B. Noranda would evaluate fish populations during operations and assess possible accumulations of cadmium, mercury and lead in fish. Noranda would conduct routine laboratory toxicity testing to monitor the potential acute toxicity present in, when such waters are available, (1) mine and adit water discharged to the land application disposal area, and (2) decant waters from the tailings pond. For pre- and post-operational monitoring, waters for toxicity testing would be collected during aquatic monitoring in August. This testing is fully described in Appendix B. This additional testing and evaluation would assist in evaluating potential effects to aquatic life.

The proposed diversion of Little Cherry Creek during placement of the tailings pond is estimated to cause an annual loss of 330 interior redband rainbow trout. Using this information and several assumptions that follow procedures published by the

American Fisheries Society (AFS, 1982), KNF personnel estimate that the monetary value of the fish lost over the estimated life of the mine is $73,140 (R.D. Perkinson, KNF memo, July 1992). This economic impact is largely based on lost recreational fishery potentials associated with Little Cherry Creek. Impacts related to recreational access to this creek, and loss of sensitive species habitat, would persist beyond the life of the project. Due to these long-term impacts, the agencies have proposed the mitigation described in Chapter 2.

The proposed mitigation is estimated to approximate the dollar value of the fishery lost from Little Cherry Creek. It would likely result in a net savings to the State of Montana, if a self-sustaining fishery establishes itself at Howard Lake to replace the fishery currently maintained by stocking. Mitigation would proceed under supervision of the KNF and State fisheries biologists.

The agencies' modification also includes plans to improve fish passage and habitat in Midas Creek. These modifications, in conjunction with Noranda's proposed introduction of a spawning fish population in Midas Creek, would increase the fish population in Midas Creek.

Under Alternative 2, redband mitigation may eventually restore the Libby Creek population to Conservation Population status (at least 98% genetically pure). This effort could take approximately ten years, but would be hindered by periodic fishkills. Alternative 3 water treatment would mitigate for anticipated effects on bull and redband trout, plus ensure the success of the redband restoration effort.

ALTERNATIVE 3

Under all options of Alternatives 3A and 3B, projected nitrate concentrations are at or below 1 mg/L, the concentration expected to produce increased algal growth. Some increased nitrate concentrations and algal growth would occur under Options A or B; the algal growth would increase the overall productivity of the area streams. The increased algal growth is not expected to lead to the eutrophic conditions described under Alternative 1.

Option 3C would result in increased land application disposal of excess water in the Little Cherry Creek area. Using a high range of nitrate and ammonia concentrations in the analysis, projected concentrations of nitrogen under Alternative 3C during Year 3 would exceed those which may result in growth of undesirable aquatic life. Noranda would conduct additional monitoring and change its operating plans, if necessary, to ensure protection of fish and other aquatic life.

IMPACTS COMMON TO ALTERNATIVES 4, 5 AND 6

Constructing the transmission line has some potential to add sediment to streams, including the Fisher River and Libby Creek. Sediment would originate from structure sites and access roads. The sediment increases would be neither large enough nor of sufficient duration to noticeably affect fish populations, due to mitigation measures required by the DNRC and the KNF. These measures and potential impact-causing activities are discussed in detail under the *Surface Water Hydrology* section.

ALTERNATIVES 4 AND 5

Using a helicopter instead of a bulldozer to pull the sock line for transmission line construction would reduce contributions of sediment to the Fisher River and to Ramsey Creek. Crossing Libby and Howard creeks only on existing bridges would nearly eliminate sediment increases in these streams. Effects of sediment on fish populations of the four streams would be less than the effects of Alternative 1.

ALTERNATIVE 6

The impacts of Alternative 6 on the Libby Creek drainage would resemble those described for the other transmission line alternatives. Impacts to the Fisher River drainage would be less than the impacts

of Alternative 1 and slightly greater than impacts of Alternatives 4 and 5. Reducing sediment by eliminating bulldozer crossings would be offset by increased sediment at the Schreiber Creek crossing (see *Surface Water Hydrology*). Alternatives 1, 4 and 5 would not affect this creek.

CUMULATIVE IMPACTS

Timber operations in the Libby Creek drainage, in association with the Montanore Project and other foreseeable activities, would result in unknown increases in productivity due to nutrient effects and potential improvements in streambed stability. Flood stage turbidity levels between Midas Creek and U.S. 2 would occasionally reduce insect production and possibly fish abundance. The KNF's Best Management Practices for logging would minimize but not eliminate these adverse changes. There would be no cumulative impacts to fish or aquatic life from the proposed ASARCO Rock Creek Project.

RESOURCE COMMITMENTS

Restoration of the redband population in Libby Creek would be an additional long-term benefit of Alternatives 2 or 3. Alternative 1 would result in a slight increase in suspended sediments that may improve habitat stability in Libby Creek, but nutrient changes would result in cumulative adverse effects on fish and other aquatic life. Alternative 2 and 3 would reduce these effects substantially due to better water quality protection and treatment, and compensate for the unavoidable consequences through more fish habitat mitigation and adaptive monitoring. The effects of increased metals on aquatic life in not known.

Alternatives 4 through 6 represent a lower risk of sediment effects from the transmission line (relative to Alternative 1), but they mainly differ slightly in the location of effects.

The Little Cherry Creek diversion would reduce the available miles of habitat by three percent for the Experimental Redband Population in Libby Creek. This irreversible loss through burial of naturally productive habitat would be mitigated by marginal habitat values in the diversion channel, plus other habitat improvement and restoration work for redbands in Alternatives 2 and 3. Alternatives 4 through 6 would reduce unavoidable effects on both redbands and bull trout.

Alternatives 1 and 7 could result in an irreversible loss of genetic diversity either due to burial of a few fish unique to Little Cherry Creek, or because of continued mixed breeding between redbands and hybrid "cuttbows". Until the Libby Creek fish population responds to habitat improvements and other restoration and mitigation activities by increasing their numbers, there would be an irreversible loss of fish, redband and bull trout production as a result of the tailings impoundment, diversion channel, and unavoidable indirect effects from the project.

ALTERNATIVE 7

Under this alternative, productivity of fish and other aquatic life in Libby Creek drainage would continue to be limited by past natural and human-caused adverse habitat changes, by naturally low nutrient concentrations, and by natural habitat limitations from periodic floods and other climate and geology influences.

Bull and "cuttbow" populations would continue to be marginal and in need of restoration work. Over time, the remaining genetically pure interior redbands would replace by hybrid "cuttbows". The bull trout may also decline or disappear from Libby Creek due to possible competition from the hybrid "cuttbows" or from other human-related causes. This loss of a unique population of native redbands or bull trout would represent an irretrievable loss of genetic diversity if allowed to occur. State and Federal agencies may attempt to stop this loss depending upon available funding.

Improvements in habitat quality and productivity due to natural healing processes would be largely negated

by the cumulative effects of continued forestry activities. Placer mining. possible private land development, and recreational use would also inhibit fish population increases. Adverse changes in aquatic life due to nitrate pollution from the Libby Creek adit would disappear within a decade as adit water quality returns to natural groundwater conditions.

WILDLIFE

SUMMARY

Alternative 1 would physically disturb about 1,270 acres of wildlife habitat. An additional 19 acres have been disturbed with the construction of the Libby Creek adit. Wildlife use of the disturbed areas, particularly big game species, would be disrupted and may be displaced during the life of the operation. Successful reclamation of disturbed areas after mining would result in the revegetation of disturbed areas and the eventual restoration of useful habitat.

Indirect impacts to wildlife during operations would result from increased human activities. The extent and location of these impacts is difficult to predict. Mountain goats, moose, elk, and grizzly bear would be the species most likely affected. Noranda would implement a grizzly bear mitigation plan consisting of habitat replacement and grizzly bear mortality reduction through habitat protection and implementation of road closures on National Forest System lands.

The agencies' grizzly bear mitigation, as part of Alternatives 2 and 3, would be similar to Noranda's. The agencies plan would include fewer road closures and more habitat protection. Additional measures would be designed to reduce mortality risk. Other modifications under Alternatives 2 and 3 would reduce indirect wildlife impacts. Under Alternatives 3B or 3C, land application may not be necessary, slightly reducing the amount of disturbed grizzly bear habitat.

Alternatives 5 and 6 would result in less displacement of elk from areas affected by the transmission line in comparison to Noranda's proposal. Alternative 6 would have the least effect on big game, particularly elk. Wildlife impacts described in the six action alternatives would not occur under Alternative 7.

ALTERNATIVE 1

Surface disturbances associated with the proposed mine would affect about 1,270 acres of wildlife habitat (Table 4-27). An additional 175 to 200 acres would be affected by the transmission line; 24 acres are in clearcuts and would not require clearing (Table 4-28). Wildlife use of these areas, particularly big game species, would be disrupted during the life of the operation. Wildlife species would be displaced to other areas. Songbird and small mammal species which depend exclusively on the habitat types disturbed by mining would experience population reductions within the wildlife project area in proportion to habitat lost.

Existing clearcut habitat would comprise half of the total disturbed area. Timbered habitat would make up the majority of the remaining affected area, with Riparian, Grassland and Shrubfield habitats insignificantly affected.

Table 4-27. Wildlife habitat acreage disturbed by mine facilities and road construction.

Habitat	Plant site	Tailings impoundment	LAD area§	Libby Creek adit to Ramsey Creek Road	Ramsey Creek plant site to U.S. 2	Total
Clearcut	0	491.7	26.8	13.4	16.3	548.2
Grassland	0	0	0	1.9	0	1.9
Lodgepole	0	24.2	0	0	0	24.2
Mixed conifer	0	421.3	4.3	7.6	44.6	477.8
Riparian	0	0	0	1.9	0	1.9
Shrub field	24.6	0	9.8	0	19.5	53.9
Spruce-fir	20.3	0	0	9.6	10.8	40.7
Western hemlock	0	57.5	37.1	0	30.2	124.8
Total	44.9	994.7	78.0	34.4	121.4	1,273.4†

Source: IMS Inc. 1990.
§Minimal disturbance (tree and shrub clearing) of 221 acres for the LAD area also would occur

Noranda would remove some existing vegetation prior to construction of the proposed land application disposal area. Discharges of excess water would increase significantly the amount of water the LAD area receives. The LAD area might convert to a different habitat type than those currently present. Although the nature of this habitat cannot be determined, the land application disposal area would be available to some species.

Important Wildlife Species

Mountain goats. Mountain goats would not be directly affected by habitat disturbance. Constructing the transmission line along Ramsey Creek would probably not affect wintering mountain goats. However, cumulative noise and human activity associated with plant construction in Ramsey Creek might move goats inhabiting Ramsey Creek to other portions of their home range for the duration of

Table 4-28. Acres of wildlife habitats and soil disturbance by transmission line construction.

Alternative	Transmission line: Forest clearing†	Transmission line: ground disturbance§	Off-ROW access ground disturbance	Old Growth clearing and* disturbance
1	193	105	23	50
4	203	32	18	61
5	183	26	20	46
6	200	29	13	74

Source: Department of Natural Resources and Conservation. 1991.
†Clearing removes trees and shrubs 5 feet or taller for 100-foot wide ROW; wider in old growth.
§Ground disturbance includes complete vegetation removal and soil disturbance for: 0.15 acre per pole, 0.05 acre per pull site, 0.34 acre per storage yard, 12-foot wide cat trails and access roads.
*Estimated disturbance of old growth is based on clearing a 200-foot wide ROW and ground disturbance for 12-foot wide off-ROW access roads.

construction activities. Goats would likely return to Ramsey Creek following construction.

Poaching of mountain goats might increase throughout the Cabinet Mountains as more people enter mountain goat habitat. Since mountain goats have a relatively low reproductive rate, any increase in mortality could have significant adverse effects on mountain goat populations.

Elk, moose, deer and black bear. The Miller Creek transmission line route passes through more elk security range than the other alternatives (Table 4-29). More roads would be required due to fewer existing roads.

The berms proposed at the road entrance would not be effective barriers to motorized vehicles. Small all-terrain vehicles and motorbikes could be driven over the berms and, depending on adjacent terrain, larger 4-wheel drive vehicles could be driven around the berms. Gates could be used with or in place of the berms, but they also could be circumvented or pulled down. Even with the most effective barriers, the roads would encourage people on horses or afoot to enter the elk security areas (McCollough et al. 1987; Canfield, 1988).

Elk hunters may use the access roads to hunt the Miller Creek headwaters. Elk that leave the headwaters to avoid hunters may encounter cleared areas, or areas more accessible by road, where they would be more likely to encounter hunters. Constructing the powerline during the hunting season would create even greater displacement effects.

Habitat disturbance within the elk security area would have little impact on elk. Twenty-three acres would be disturbed within the 39 acres which would require tree clearing (Table 4-29). Tree clearing may increase forage for elk; however, the benefits would be small since forage supplies are usually adequate on summer-fall ranges and the addition of 39 acres to those areas would not produce large amounts of forage.

Elk share the winter range along Miller Creek with deer and moose (Figure 3-9). Similar to impacts in the elk security area, human activities in winter range would have more adverse effects than would habitat

Table 4-29. Big game range affected by transmission line construction.

Alternative in type of range	Distance crossed by right-of-way	New access roads	Acres of tree clearing†
*Elk security range**	——miles——		
1	1.8	3.0	39
4	2.4	1.4	22
5	1.6	0.8	16
6	0.3	0.1	7
Winter range§			
1	3.8	2.8	34
4	4.4	2.6	37
5	3.6	2.0	30
6	0.4	0.3	6

Source: Department of Natural Resources and Conservation. 1991.
†Reduced by acreage already in clearcuts (no new clearing required).
*Range used by elk during summer and fall as identified by DFWP and USFS.
§Range for moose, deer, and elk as identified by DFWP.

loss (Table 4-23). Line construction, including blasting, with a 23-person crew could occur during winter. This activity would displace big game animals from range near the transmission line. Displacement distance for big game species cannot be predicted precisely; published studies suggest it may range from 1/8 to 1/2 miles (Ward, 1976; Ward, 1985; Knight, 1980; Ferguson and Keith, 1982; Perry and Overly, 1977; Rost and Bailey, 1979). If this displacement were to occur, a major portion of the Miller Creek winter range would be lost. Because winter range often determines big game population levels (Mautz, 1978), populations relying on the Miller Creek range might decline.

Tree clearing would increase forage in the Miller Creek winter range; however, this benefit would not be great enough to offset the negative effects of displacement (Table 4-29). Impacts of improved vehicle access into winter range would be limited by snow blocking the roads. Snowmobiles may still be able to travel through the winter range. Deer and other big game animals would avoid roads during periods of snowmobile use (Dorrance et al., 1975).

Construction and operation of the tailings impoundment and the land application disposal area would result in the loss of about 1,070 acres of moose winter range. Research studies conducted by the Montana Department of Fish, Wildlife and Parks during the winter of 1991-1992, indicated that approximately 6 to 12 moose per square mile occupy the tailings impoundment area (J. Brown, MDFWP Biologist, memo to J. Cross, 12/27/91). Animals currently using these areas would be displaced to adjacent winter range. If this displacement causes the wintering moose population to exceed the carrying capacity (the capacity of the land to support a given wildlife population), the moose population may decrease by the number of animals by which the carrying capacity is exceeded. It is expected, however, that the grizzly bear mitigation efforts also would benefit moose, partially offsetting the loss.

Keeping the Bear Creek Road open throughout the year would result in more recreational use of this area during the winter. Much of the area is moose winter range. Human interactions with moose would increase during winter, and would likely result in stress to moose during a period when other stress factors are also high. The result might be some moose mortality due to starvation or disease, but more likely increased access would result in increased poaching and road kills.

Habitat within 0.25 mile of the mine facilities and access road would probably receive less use by big game due to human activity at the facilities and along the road during the construction phase. There would continue to be a zone of influence of up to 0.25 mile at the plant site and along the access road during operation, but this zone of influence probably should not affect big game use at the tailings pond and the land application disposal areas. The exact extent of this zone of influence would vary depending on the ability to habituate and tolerance of the wildlife species and habitat type involved. Most big game species will habituate to human activity, but unhunted populations habituate more readily. Of the species occurring in the project area, black bear and elk are the least tolerant of human activity while deer are the most tolerant. The zone of influence would be less in habitats which provide good hiding cover such as timbered areas and old clearcuts. The 500 percent increase in traffic on the access roads would result in a proportional increase in traffic accidents involving big game.

Although much more difficult to predict and quantify, indirect impacts to big game would likely be greater than direct impacts. Big game species range throughout the project area might be affected by both increased hunting and recreational road use. A projected 2 percent population growth is also expected to occur in Lincoln County as a result of the project. Increased motorized recreational activity might reduce habitat use near roads in the Cabinet Mountains. Increased non-motorized activities might decrease habitat utilization.

An additional effect of increased hunting is that it causes black bears to be more wary of human activity. Black bear use of habitat may decrease near roads and trails where hunting occurs.

Improper garbage containment at mine facilities might act as a bear attractant. This has two potential effects. One is the obvious effect on human safety. The other is that bears may habituate to human activity and become problem bears. The presence of problem bears at the mine would necessitate efforts to relocate problem bears. Repeated relocation failures or unusual circumstances may result in the death of individual problem bears.

Other wildlife. Other wildlife species would be directly affected by habitat disturbance. They would also be susceptible to some of the indirect impacts resulting from increased human population and activity. Small game species would be susceptible to both legal hunting and poaching. Most small mammals would be susceptible to road kills. These losses are expected to be very small.

Waterfowl might occasionally collide with transmission line ground wires at crossings of the Fisher River and Howard and Libby creeks. Annual mortality would be insignificant due to low flight intensities.

Habitat disturbed by the transmission line and associated roads would have only negligible effects on raptors, songbirds, and small mammals in the transmission line corridor (Table 3-23). A few potential and actual nest sites in snags or cottonwoods, would be lost to tree clearing. A small number of trees used by perching raptors also might be removed. Species of songbirds and small mammals inhabiting cleared areas would differ from those that inhabited the undisturbed forests.

Threatened, Endangered or Sensitive Species Other Than Grizzly Bear

Peregrine falcon and bald eagle are unlikely to be significantly affected by mining activities because they rarely enter the proposed mine area. Changes in water quality in the Kootenai River downstream of its confluence with Libby Creek probably would not be detectable. It is unlikely that such changes would affect bald eagle habitat along the Kootenai River. Construction of the transmission line may remove suitable perching habitat along the Fisher River. Affected eagles would be displaced to surrounding areas, where suitable habitat is available.

Constructing the tailings impoundment in Little Cherry Creek and upgrading of the Bear Creek Road would affect potential Coeur d'Alene salamander habitat. About 5.8 acres of Little Creek Creek would be filled or dewatered by the tailings impoundment or the diversion channel. It is unknown what portion of this disturbance would be comprised of suitable Coeur d'Alene salamander habitat. Any Coeur d'Alene salamander occupying the habitat in Little Cherry Creek would be destroyed.

About 503 acres of potential black-backed woodpecker habitat would be disturbed by construction of the tailings impoundment. Any nesting occurring in this habitat would be destroyed. Suitable habitat occurs adjacent to the areas proposed for disturbance.

Suitable old-growth habitat for the flammulated owl would be affected by the proposed project. Owls using this habitat would be displaced to adjacent habitat. If suitable adjacent habitat is unavailable, flammulated owl populations would be reduced.

Since Townsend's big-eared bat is not known to occur in the project area, it is unlikely to be adversely affected by Montanore Project activities. In the long term, the two adits created for the Montanore Project may provide habitat for Townsend's big eared bat once the project is finished. If adit plugging is proposed as part of a closure plan, the presence of the Townsend's big-eared bat would be evaluated during evaluation of the closure plan.

The Montanore Project would cause some disturbance of fisher habitat. However, the project is unlikely to affect fisher populations since the species has been recently reintroduced to the Cabinets and the population is expanding.

Constructing the transmission line would add minor amounts of sediments to tailed frog habitat in the Libby Creek drainage (see *Surface Water Hydrology* section). The levels and duration of sediment increases, however, probably would not be enough to harm tailed frogs.

Other sensitive species, such as the boreal owl, lynx, and northern bog lemming, would not be affected by the proposed project.

ALTERNATIVES 2 AND 3

These alternatives would reduce mortality risk to the grizzly bear and also reduce project effects to other wildlife. Restricting firearms and setting speed limits on access roads would reduce mortality of big game animals. Closing Road #6747 during the winter months would reduce the expected displacement of moose in the tailings impoundment area.

One option under Alternative 3 would be the use of additional LAD areas in the tailings impoundment area. Increased displacement of moose in the Little Cherry Creek LAD area over that projected for Alternative 1 could occur.

IMPACTS COMMON TO ALTERNATIVES 4, 5, AND 6

The primary effect of transmission line alternatives on the grizzly bear would be displacement during the period of construction. This displacement could be a problem when considering value of the spring range and associated displacement due to other mine construction. The effects of displacement would be reduced if timing of construction for the transmission line was done to avoid activity during the spring use periods by the grizzly bear.

Table 4-29 shows the miles crossed and acreage affected by each alternative for elk security range and big game winter range. Alternative 4 would affect big game range more than Alternatives 5 or 6. Alternative 6 would have the least effect of any alternative on big game. Wildlife impacts would be avoided mostly by building the transmission line when animals are not using winter range and closing new access roads to public use. Areas where the need for timing restrictions have been identified and where clearing of old growth habitat would occur are shown on Figure H-1 and discussed in Appendix H under Wildlife.

A road management agreement for the transmission line access roads would be developed by Noranda and the agencies to protect wildlife against impacts of increased motorized access. New roads constructed for the transmission line would be closed to public travel by motorized vehicles.

All transmission line alternatives would require removal of cottonwood trees, conifers, and shrubs, such as alder and willow, at the Fisher River crossings. Conifers and shrubs would be removed at the crossings of Libby, Howard, and Ramsey creeks, and at each intermittent drainage. Clearing of trees and shrubs at drainage crossings would be kept to the minimum necessary to safely construct and operate the line.

UNMITIGATED EFFECTS ON GRIZZLY BEARS–ALTERNATIVES 1 THROUGH 6

Three ecosystems have been designated by the U.S. Fish and Wildlife Service for a concentrated grizzly bear recovery effort (U.S. Fish and Wildlife Service, 1982). One of these ecosystems is the Cabinet-Yaak ecosystem (CYE), located in northwestern Montana and northern Idaho. The Cabinet portion of the ecosystem is located south and west of U.S. 2 and the Yaak portion is located north of the highway. The Montanore Project is located in the Cabinet portion of the CYE.

One of the tools used for this assessment was a model, details of which are described in the *Cumulative Effects Analysis Process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems* (U.S. Forest Service, 1988). The model is referred to as the Cumulative Effects Model.

Habitat units reflecting the quality of a given land area can be generated using the model. Habitat units represent, in part, the value of an area for grizzly bear use. Habitat units do not reflect the influence of various activities on an area. The basic analysis unit in the model is the mapped habitat component or vegetation polygon, which describes a discrete vegetative or topo-edaphic unit. Each habitat component type is given seasonal coefficients on the basis of seasonal grizzly bear food potentials. A complete description of the procedures used to calculate habitat units is in the KNF project file.

Project construction would have both direct and indirect effects on the grizzly bear. Direct effects are those on-site activities which would alter habitat, displace bears from habitat they normally use, or affect the productivity, survival, or mortality of the grizzly. Indirect effects are those caused by a proposed action, but occur later in time or outside the project area. Increased off-site (beyond the permit area) recreation which is not directly related to the operation of the mine would be an indirect effect. Indirect effects also may reduce grizzly bear productivity, survival, and mortality.

Direct impacts. The Montanore Project during the operation phase would have a direct effect on grizzly bear habitat by physically altering approximately 1,270 acres, and also influencing an additional 3,000 acres. During the construction phase, an additional 4,160 acres of habitat would be influenced, including 50 acres of physical disturbance and 233 acres of tree clearing resulting from the transmission line (Alternative 1). In terms of habitat quality, about 785 habitat units would be affected as a result of the operation of the mine-related facilities (Table 4-30). Construction of the mine facilities and the transmission line would affect an additional 739 habitat units temporarily during the construction phase. Much of the affected habitat would occur in the upper Ramsey Creek drainage which currently has very little activity. The coniferous forest habitat component would be the type most affected by mine facilities. The mixed shrubfield, marsh, riparian stream bottom, and dry meadow components would also be affected, but to a lesser degree.

Displacement of bears currently occupying the project area may occur because of increased human activity in the project area. Disruption of normal behavior patterns could occur. Bears would tend to avoid areas of activity, and consequently would lose available habitat, or habitat would be less effective. Bears would likely avoid the project area more during the construction phase than during the operational phase, since construction activities would generally be more intense (louder and longer) and more widespread than during operational activities.

During the construction phase of the Montanore Project, bear use was expected to decrease in an area 0.50 miles around the tailings impoundment, LAD areas, powerline corridor, and associated access

Table 4-30. Habitat units affected by project activities (Alternative 1).§

Facility	Habitat units
During operations	
Plant site	55
Ramsey Creek drainage†	564
Tailings impoundment	49
Borrow areas	35
Libby Creek adit	13
Ramsey Creek LAD area	44
Access roads	25
Total	785
During construction (temporary)	
Transmission line	177
Other mine facilities	562

Source: KNF, 1992. *Biological Assessment* (see Appendix C)
Detailed calculations available in project file at the KNF Supervisor's office.
§Transmission line alternatives:
Alternatives 1 and 4–177 habitat units,
Alternative 5–463 habitat units,
Alternative 6–198 habitat units;
†Area currently has little disturbance.

roads. For the plant site in upper Ramsey Creek, influence zones were extended beyond the 0.50 mile zone to include the entire basin area up to the ridgeline.

During the operation phase of the mine, bear use was expected to decrease in an area 0.25 miles around the tailings pond and associated roads. No influence zones were assigned to areas surrounding the percolation ponds or powerline corridor since these areas will not be subject to motorized activities on any regular basis. The influence zones for the plant site in upper Ramsey Creek remained the same as those assigned for the construction phase, due to the projected level of activity. Under the present situation, some displacement already occurs in the proposed project area, particularly near the land application disposal area and tailings impoundment, because of human use on existing roads.

The east side of the Cabinet Mountains provides important spring habitat, which is very limited in Bear Management Unit (BMU) 5 (Madel, 1983). Due to the operation's yearlong activity, the Kootenai Forest practice of avoiding spring habitat during the period from April 1 to June 15 would not be met.

It does not appear that any denning habitat would be physically affected by the project. Most of the facilities would lie in or near drainage bottoms where there is no evidence of denning. Activities during construction, particularly blasting at the adit portals, may influence bears attempting to den in the upper Ramsey Creek basin.

A possibility of increased mortality to grizzly bears exists as a result of project-related activities. Grizzly mortalities may result from the shooting of bears by employees. Bears that might be attracted to the project area by garbage refuse or purposeful feeding could become nuisances or cause damages. Such bears can be relocated, but a nuisance bear is usually eventually killed.

Previous cumulative effects analysis procedures (Christensen and Madel, 1982) used a threshold of 70 percent freely available space (undisturbed habitat) within each bear unit. Forest-wide standards and guidelines for grizzly bear management, described in the Forest Plan, (Kootenai National Forest, 1987) require that 70 percent freely available space be present within BMU 5 and 6 (see Figure 4-5) before additional activity can be permitted. The 70 percent freely available area must also be contiguous within the BMU with no major barriers preventing a bear's movement in or through the entire freely available area. If this condition is not present at any given time, the KNF considers options to bring the space requirement up to at least the 70 percent minimum threshold before permitting any activities. The two BMUs affected by the project are presently above the 70 percent threshold. The project would not reduce any of the units below this threshold (Table 4-31).

The KNF road density standards require less than 0.75 mile of road per square mile in each timber compartment. Construction of the project would exceed KNF road density standards in two timber compartments. (Table 4-32).

Table 4-31. Freely available (uninfluenced) habitat in BMUs 5 and 6.

Area	—BMU 5—		—BMU 6—	
	(sq. mi.)	(%)	(sq. mi.)	(%)
Total	103	—	107	—
	—Available space—			
Currently	83	81	81.5	76
With Montanore				
Construction phase				
Without mitigation	71.8	70	79.2	74
With agencies' mitigation	71.8	70	81.9	77
Operation phase				
Without mitigation	76.0	74	81.5	76
With agencies' mitigation	76.0	74	84.2	79

Source: KNF. 1992. *Biological Assessment* (see Appendix C)
Calculations available in project file.

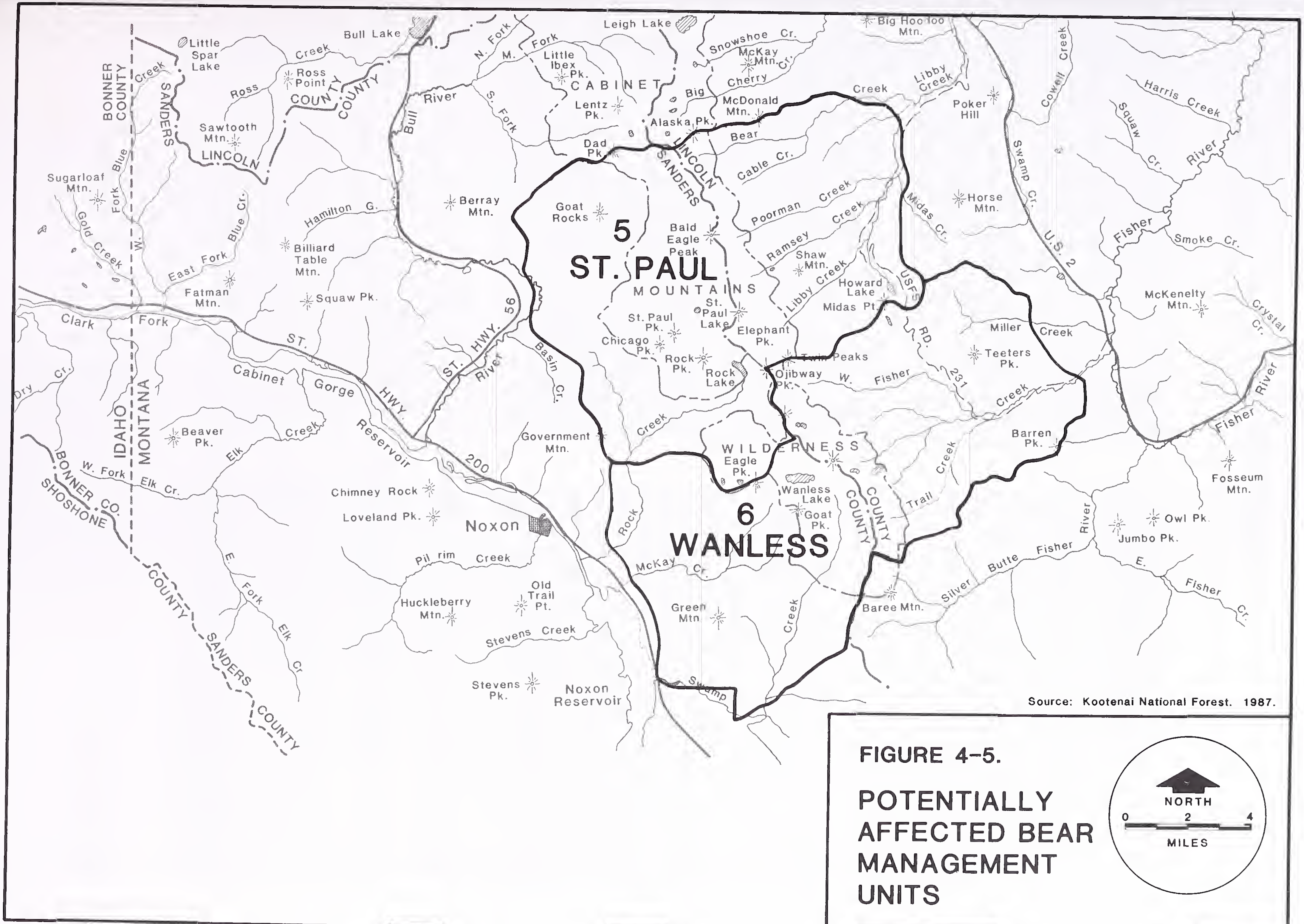


FIGURE 4–5.

POTENTIALLY AFFECTED BEAR MANAGEMENT UNITS

Indirect impacts. Indirect or off-site effects are those effects that occur away from the project site or later in time. Patterns and intensity of recreational use may change as a result of the project. Current recreational users may avoid project activities, and thereby increase recreational use in adjacent areas. Also, increased recreational use may occur as construction and mine workers become familiar with surrounding recreational opportunity and as a result of a slight increased population. Human population increase would lead to increased recreational use of bear habitat. This raises the potential for grizzly displacement, and increased human/grizzly conflicts which can result in grizzly mortality.

Current grizzly bear mortality in the Cabinet-Yaak Ecosystem is not accurately known, but is thought to be high (Knick and Kasworm, 1989). Human-caused mortality is one of the main factors in the demise of the grizzly bear in the Cabinet ecosystem. At a minimum, 61 known mortalities were documented from 1950 to 1990 (Kasworm and Thier, 1990). Trails and roads that provide access to primary attractions such as lake basins or scenic viewpoints receive a large percentage of the total use in the Cabinet Mountains Wilderness and surrounding roaded areas (KNF Libby Ranger District recreational use files, 1990). These routes probably would receive increased use proportionate to the anticipated recreation increase. With more people entering grizzly habitat during spring, summer and fall months, certain areas would probably become less secure habitat. As more people/bear interactions occur over time, the potential for human-induced mortality also rises through removal or illegal kills (Martinka, 1982).

Patenting of mining claims and mill sites by Noranda could lead to development of these lands in a manner detrimental to the grizzly bear after mine closure and reclamation. Noranda has applied for patent to mining claims on the apex of the mineral deposit within the Cabinet Mountains Wilderness. If patent to these claims is issued, Noranda would obtain title to both the surface and mineral estates on 14.5 acres outside the wilderness, and the mineral estate only on 22.1 acres inside the wilderness. Noranda has applied for patent of their HR 133 and HR 134 mining claims. (This issue is discussed in greater detail under *Kootenai National Forest* section of Chapter 1). Although it is not known what mill sites, if any, Noranda might patent, they may have the right to patent any of the mill sites which they occupy. Lands that could be patented include the plant site and tailings impoundment.

Effects of Alternatives 4, 5 and 6. The preceding discussion of effects on grizzly bears includes some discussion of transmission line Alternatives 1 and 4. Selection of Alternative 5 or 6, however, would

Table 4-32. Road density projections for compartments 36, 37, and 43.

	As of 9/1/92			With Montanore (Alternatives 1-6)					
				Construction phase			Operations phase		
Compartment	Total area (sq. mi.)	Roads (miles)	Density (mi./sq. mi.)	Total area (sq. mi.)	Roads (miles)	Density (mi./sq. mi.)	Total area (sq. mi.)	Roads (miles)	Density (mi/sq mi)
#36	9.3	6.7	0.67	9.3	6.7	0.67	9.3	6.7	0.67
#37	27.1	20.4	0.75	27.1	24.4	0.90	27.1	20.4	0.75
#43	7.7	5.8	0.75	7.7	9.5	1.20			Spring = 0.13 Summer/fall = 0.75

Source: KNF. 1992. *Biological Assessment* (see Appendix C)
Calculations available in project file.

result in construction of a transmission line along a route different than Alternative 4. These alternatives would have slightly different effects on grizzly bears. The following is a discussion of the difference in effects to grizzly bears that would be expected under Alternatives 5 or 6, as compared to Alternative 4.

Alternative 4 would affect 177 habitat units during construction and about 950 acres of additional space. This compares to 463 habitat units and 2,743 acres of space affected by Alternative 5, and 198 habitat units and 1,270 acres of space affected by Alternative 6.

Alternatives 5 and 6 would result in the same amount of undisturbed grizzly bear habitat in Bear Management Unit 5 as that presented in Table 4-29. During construction phase, Alternative 6 would provide more freely available habitat (84.2 sq. mi.) in BMU 6 than for Alternative 5 (81.9 sq. mi.) or Alternative 4 (82.7 sq. mi.).

The transmission line length and new access roads in BMUs 5 and 6 would be greater for Alternative 4 than for Alternatives 5 or 6. Alternative 4 would include 8.9 miles of transmission line in grizzly bear habitat mapped by the KNF in the BMUs versus 6.5 miles for Alternative 5 and 3.6 miles for Alternative 6. New access roads constructed in BMUs 5 and 6 would be 4.7 miles for Alternative 4 versus 4.1 miles for Alternative 5 and 1.2 miles for Alternative 6. Effects from the transmission line and associated roads would be greatest during construction, as access roads would be closed when construction is completed and little to no activity would be associated with the line during operations, except for line maintenance. Maintenance activities could be timed to avoid seasonal habitat use by grizzly bears.

Alternative 6 would result in less new roads in BMUs 5 and 6 and would better avoid the Miller Creek drainage than the other two transmission line routes. Differences between transmission line routes are not significant, however, since effects on grizzly bears from the transmission line are only a small part of the total project.

EFFECTS OF NORANDA'S PROPOSED MITIGATION PLAN–ALTERNATIVE 1

Noranda has proposed a mitigation plan intended to compensate for effects on grizzly bears resulting from their proposed operation. Noranda's plan is presented in Chapter 2. The plan specifies measures to reduce grizzly bear mortality and replace habitat affected by the operation. The proposed mitigation plan and its ability to compensate for project effects on grizzly bears is discussed in the following sections.

Mortality Risk Mitigation

Noranda would reduce grizzly bear mortality risk by funding a full-time local enforcement officer and establishing a public education program. Increased enforcement would act as a deterrent to illegal shooting of grizzly bears. As previously discussed, shooting of grizzly bears has been one of the main factors affecting the bear population in the project area. Noranda also would fund a local education and information position. This person would provide information regarding the grizzly bear recovery program for the project area, and educate the public and local groups about grizzly bear needs and issues affecting bear survival. Public acceptance and support of grizzly bear management is a vital aspect of bear management. This position would encourage local acceptance and support of grizzly bear recovery efforts, thereby helping reduce grizzly bear mortality. Providing law enforcement and information could have an immediate and long lasting beneficial effect on grizzly bears, and would help compensate for increased mortality risk to the bears as a result of the project.

Noranda has further addressed the mortality issue by suggesting evaluation of selective restrictions of the hunting seasons in areas of high grizzly bear use. Although Noranda's plan does not specify what these restrictions would be, two frequently mentioned changes include closing the fall black bear season on November 1, and removing the black bear

tag from the sportsman's license. These restrictions were recommended by Kasworm and Manley (1988). Black bears in the Cabinet Mountains tend to be in their dens by the end of October, while grizzly bears tend to den in late November or early December (Kasworm and Manley, 1988). Closing the black bear season on November 1 probably would reduce accidental shooting of grizzly bears by black bear hunters.

Documented grizzly bear mortality recently has been associated with elk hunters in the Cabinet Mountains. Removing the black bear tag from the sportsman's license and requiring a separate bear license would license people who would actually be hunting bears and who may be more adept at bear identification.

The KNF does not have the authority to restrict hunting seasons. Early closure of the black bear season would have to be done by the Montana Fish, Wildlife, and Parks Commission, while removing the black bear tag from the sportsman's license would require action of the Montana legislature.

Road closures are discussed in the *Habitat Replacement* section. Closures serve a dual role by making habitat available and, sometimes more importantly, by providing secure areas and reducing mortality risk.

Habitat Replacement

Noranda's proposal to compensate for effects on grizzly bear habitat include road closures, habitat acquisition, and habitat enhancement and protection. Seasonal and year-round road closures would compensate for about 50 percent of the affected habitat units. These road closures would be implemented by the Kootenai National Forest. Land acquisition and enhancement would compensate for the other 50 percent of affected habitat units. Acquisition would consist of fee title acquisition or purchase of conservation easements, and would be in effect within 6 years from the start of construction.

Road closures. Noranda has identified about 18 miles of road that could be closed on a year-round basis and 20 miles of road that could be closed seasonally. Noranda believes, however, that it would be necessary to close only 11.1 miles of road to effectively mitigate habitat losses. Of the 11.1 miles, 7.1 miles would be year-round closures and 4.0 miles would be closed in spring and early summer. The three roads that Noranda has identified as priorities for closure are the Libby Creek Road (#2316), the Cable-Poorman Road (#6214) and the Midas Creek Road (#4778). The Libby Creek and Cable-Poorman Roads would be year-round closures. The Midas Creek Road would be a seasonal closure during spring and early summer. If these roads do not provide adequate habitat mitigation, the other roads Noranda proposed could be closed based on priority are: Bear Creek Road (#4784), Upper Fisher Creek Road (#6746), Bramlett Creek Road (#2332), Lake Creek Road (#6748) and lower Granite Creek Road (#4791).

One of Noranda's proposed permanent road closures is already scheduled for closure by the KNF in 1992. This is the Cable-Poorman Road (#6214). Closure of this road is needed to meet road density standards set by the KNF Forest Plan. The agencies will not consider this road as compensation for the Montanore Project.

Of the remaining year-round closures, the upper West Fisher Road #6746 would be most beneficial to grizzly bears. The area has habitat components similar to those that would be impacted in the upper Ramsey Creek area, and would provide a displacement area for grizzly bears affected by activities in the Ramsey Creek drainage. These closures would provide 175 to 250 habitat units for compensation, depending on the precise closure location (Table 4-33). The Bramlett Creek Road #2332 and Lake Creek Road #6748 are within summer and fall grizzly bear habitat. These closures would provide approximately 200 habitat units for grizzly bear compensation. Road closures not only would provide additional undisturbed space, but also

Table 4-33. Habitat units that could be gained by road closures.

	Year-round closure	Seasonal closure
Lower Granite Creek	—	262
Miller Creek	—	312
Midas Creek	—	308
Libby Creek	22	—
Bear Creek	154	—
Cable-Poorman	126	—
West Fisher	175-250	
Bramlett Creek	101	—
Lake Creek	88-150	—

Source: Noranda Minerals Corp. July 19, 1991—on file with the agencies.
Actual habitat units gained from road closures would depend on specific closure location.

would decrease vulnerability to human-caused mortality. Road closures would be effective in providing immediate mitigation for project effects.

Noranda has suggested possible spring road closures for the Lower Granite Creek Road (#4791) at its junction with Road #4792, the Midas Creek Road (#4778), and the Miller Creek Road (#4724). These roads are all located along the east front of the Cabinet Mountains. Research and trapping indicates that the east front is used by grizzly bears in the spring, during the critical period after den emergence (Kasworm, 1989). Spring road closures would allow that pattern of use to continue by providing secure areas adjacent to the major disturbance occurring in the tailings impoundment area.

The Miller Creek and Midas Creek Roads are on the eastern edge of delineated grizzly habitat, and are associated with an abundance of recognized spring habitat components such as the graminoid sidehill park complexes in Miller Creek and Horse Mountain (Madel, 1982; KNF Habitat Component Mapping). These are potential displacement areas for bears in the project area vicinity during the spring. The Deep Creek area, accessed by Road #4791, receives heavy use by black bears in the spring (MDFWP trapping record files). This area also would provide potential spring displacement habitat. Particular benefit would occur during the construction period, as it would be a relatively secure area further removed from the project site. Although road closures provide additional space and security to grizzly bears, they also have social effects that must be considered. Road closures affect access to private lands, unpatented mining claims, and hunting and recreation areas. There are legal requirements to allow reasonable access to private lands and mining claims. These can sometimes but not always be satisfied while still maintaining secure habitat for grizzly bears. They are most difficult to satisfy when closures are year-round and regular access behind closed gates is required. Closing roads used by mining claimants can place additional burden on them to mitigate for effects on grizzly bears. Road closures can also result in negative social reactions that outweigh the biological gain brought by the closures. As noted above, public acceptance of grizzly bear recovery is an important part of the recovery plan. Too many road closures or closures of certain popular roads can jeopardize local support for grizzly bear recovery. Specific road closures suggested by Noranda are discussed below in the context of social effects.

Suggested year-round closures include the Upper West Fisher, Bramlett, and Lake Creek Roads. The Upper West Fisher closure would affect access to unpatented mining claims and private lands. A record search indicates that 21 individual claimants could be affected by this road closure (KNF Montanore Project Files). Of these, only two were identified who routinely submit plans to use the area for mining purposes. Based on past experience, about one trip per week would be requested by mining claimants to use the Upper West Fisher Road (J. Jeresek, KNF Recreational Forester, personal communication, August, 1991). The Upper West Fisher Road also accesses three private parcels. One

landowner has shown interest in accessing private lands within the last several years. The Upper West Fisher Road also receives some motorized use during fall hunting season (September 1 to approximately November 15), that would not be available if the road were closed. Even though total restriction of motorized use would not likely be achieved on this road, the controlled level of activity could still provide for an effective closure for grizzly bear habitat security if projections of future activity are reasonably accurate.

The Bramlett and Lake Creek roads provide access to three trailheads in the southern portion of the Cabinet Mountains Wilderness. These trailheads account for about 35 percent of the use on the east side of the Cabinet Mountains (Libby District recreational use files, 1990). Approximately 85 percent of wilderness use occurs in the months of June through September (J. Jeresek, KNF Recreational Forester, personal communication, August, 1991). Closing these two roads would add an additional hiking distance of 1.5 miles into Geiger Lake, 1.2 miles into Upper Geiger Lake (via 4th of July trailhead), and 1.7 miles into Bramlett Lake. Bramlet Creek Road also provides access to unpatented mining claims and private lands. Nine individual claimants have mining claims recorded in this area. None of these claimants, however, routinely submits plans to use this road for mining related purposes. Four private parcels are accessed by the Bramlet Creek Road. As with the West Fisher Road, total restricted access is not likely by closing these two roads, but an effective closure for grizzly bear habitat security may still be achieved.

The primary effect on the public of closing roads seasonally during spring and early summer would be to preclude motorized access during the spring black bear hunting season. Driving open roads is the primary hunting method along the east Cabinet front during the spring season.

In summary, all potential road closures proposed by Noranda would provide immediate benefit to grizzly bears by providing habitat and reducing mortality risks. These closures could affect private landowners, mining claimants, and the general public. Some of these closures would be more effective than others in providing for grizzly bear habitat security. As proposed by Noranda, these closures could provide 50 percent or more of the habitat units needed to offset impacts from the project. The agencies agree that road closures are needed as part of the mitigation plan.

Habitat acquisition. Noranda's proposed habitat acquisition program is described in Chapter 2. Noranda would acquire sufficient land to replace affected habitat units not replaced by road closures. This would amount to approximately 50 percent of affected habitat units (391 units). Under Noranda's proposal, all land acquisitions would be subject to the approval of a management committee. The committee would be composed of supervisory personnel from the U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Department of Fish, Wildlife, and Parks, and Noranda. Noranda is currently investigating several mechanisms to guarantee that funding for the mitigation plan is available.

Lands would be acquired by purchase of private lands or by acquisition of conservation easements over a 6-year period from the start of construction. Noranda would manage all lands acquired and provide an annual report to the management committee. At the end of the project and reclamation period, Noranda would retain the right to offer purchased lands for sale to a private trust or to the U.S. Forest Service.

With the approval of the management committee, Noranda would replace some lost habitat units by enhancing habitat on acquired lands. As proposed by Noranda, habitat enhancement would increase the number of habitat units available to the grizzly bear. Habitat enhancement methods may include physical manipulation of habitat such as burning, logging, and revegetation to increase habitat quality. Habitat enhancement could also include changes in

management such as closing roads to acquired parcels, reduced livestock grazing, and siting of hunting camps away from heavily used fall habitat.

Noranda's proposed habitat acquisition program would reduce impacts to grizzly bears by providing secure replacement habitat for long-term grizzly bear use. Although immediate effects may result, the primary benefit of the program would be in long-term protection of suitable grizzly bear habitat that might otherwise be developed. As previously discussed, immediate benefits to grizzly bears needed to offset impacts from the operation would be provided by road closures and by reducing mortality risks.

In total, Noranda's proposed grizzly bear mitigation provides many of the specific elements necessary to adequately mitigate for project effects on grizzly bears and their habitat. The agencies are concerned, however, that the plan relies too heavily on road closures to compensate for affected grizzly bear habitat.

THE AGENCIES' PROPOSED MITIGATION PLAN–ALTERNATIVES 2 THROUGH 6

The agencies have developed a grizzly bear mitigation plan in response to deficiencies in Noranda's proposed mitigation plan. The agencies' plan is presented under Alternative 2 in Chapter 2. It would apply to all action alternatives except Noranda's proposal included in Alternative 1. The plan is similar to Noranda's. These similarities include funding for additional law enforcement and education positions, habitat acquisition, and road closures. Other provisions also are included, and are aimed largely at reducing mortality risk. The KNF is in formal consultation with the U.S. Fish and Wildlife Service regarding the proposed grizzly bear mitigation plan. The proposed mitigation plan and its effects could change based on the Fish and Wildlife Service's Biological Opinion.

Mortality Risk Mitigation

Increases in bear mortality risk would result as a direct and indirect effect of the project. Several methods would be used to minimize and offset this risk. First, as proposed in Noranda's plan, funding would be provided for two full-time positions (enforcement and education) throughout the project life. The enforcement position would be an employee of the Montana Department of Fish, Wildlife and Parks. The education position would be an employee of MDFWP, U.S. Fish and Wildlife Service, the U.S. Forest Service or Noranda. The benefits of these positions in limiting grizzly bear mortality were discussed under Alternative 1.

Road closures also would be used to reduce grizzly bear mortality risk. The KNF would close six road segments prior to construction activities (Figure 2-23 in Chapter 2). These closures would be in addition to those discussed in Chapter 2 (Figure 2-28) to meet Forest Plan road density standards. Three closures would be year-round for a total of 6.4 miles, and three would be seasonal for a total of 18.4 miles. In addition, the closure of the upper Bear Creek Road #4784 would be extended from September 1 to June 30 (current motorized closure on this road is from October 15 to June 30). These road closures provide two functions—security and habitat replacement. Year-round closure of the upper West Fisher Road system would provide secure bear habitat similar to that affected by the project in the upper Ramsey Creek drainage. Seasonal spring closures of the Midas, Miller and lower Granite roads would provide secure habitat during the critical period after den emergence.

Additional measures to reduce direct mortality risk from the project involve limiting the amount and speed of traffic, prohibiting firearms on the work site, and reducing attractants such as garbage and road kill that might result in human-bear interactions. These measures are presented in Chapter 2. They are briefly discussed here as to their effects in reducing mortality risk. Public motorized travel would be restricted in the upper Ramsey Creek drainage to minimize human-bear interaction. Speed limits would be controlled to minimize the amount of road kill that could attract grizzly bears. Road kill would

be removed from the roads on a daily basis further reducing the potential for human-bear interaction along roads. Noranda would prohibit employees carrying firearms within the permit area. This would minimize the potential for illegal shooting of grizzly bears. Containers used for trash and garbage would be the type that would not allow foraging by bears. This would reduce a potential bear attractant and the chances for human-bear interaction.

Habitat Replacement

As with Noranda's proposed mitigation plan, grizzly bear habitat affected by the project would be replaced through road closures and habitat acquisition. Differences between the two plans include the total amount of land acquisition versus road closures, and the degree to which seasonal road closures would be used for habitat replacement. The agencies' plan would require Noranda to replace about 65 percent of the affected habitat units through land acquisition. This compares to 50 percent suggested by Noranda. The remaining habitat would be replaced by road closures. Only a portion of the habitat units gained by seasonal road closures would apply toward habitat replacement. Noranda's plan would apply all habitat units gained through seasonal closures toward habitat unit replacement. The agencies view seasonal closures largely as a mortality risk reduction measure, and would limit their use in replacing habitat units affected by year-round project activities.

Road closures. As previously discussed, the KNF would close six road segments prior to construction activities. Three closures would be year-round for a total of 6.4 miles, and three would be seasonal for a total of 18.4 miles. The closures would have an immediate benefit by providing additional security adjacent to the impacted area, and would also replace lost space and habitat units. Habitat components affected by these closed road segments, and their geographic setting, would be very similar to the components and land area impacted by the project. The road closures would off-set immediate impacts to available habitat of 13.5 square miles during construction and 7.0 square miles during operation. The closures would make available high value foraging areas currently within road influence zones. The closures also would make low elevation spring habitat and higher elevation summer and fall habitat available to grizzly bears.

The upper 6.4 miles of the West Fisher Road system would be closed year-round by closure of three road segments (#6746, #6744, and #6746 C). The West Fisher area was one of the year-round closures suggested by Noranda in their mitigation plan. Approximately 215 habitat units and 2.7 square miles of space would be made available to grizzly bears with these closures. The components associated with this area are similar to those impacted by the activities in the upper Ramsey Creek area, and would provide a displacement area similar to the upper Ramsey Creek drainage.

Seasonal road closures would be in effect from April 1 through June 30 during the project life. This includes the South Fork Miller Creek Road #4724, from its junction with the Main Miller Creek Road #385, and the Midas Creek Road #4778 from its junction with the main Libby Creek Road #231 on the north end. The southern segment of Road #4778 is scheduled for closure to meet KNF Forest Plan road density standards. The Lower Granite Road #4791 would be closed from its junction with Road #4792, also from the period April 1 to June 30. These road segments were included in Noranda's list of potential seasonal closures and discussed under Alternative 1.

The four seasonal road closures would provide 7.5 square miles of additional space for grizzly bears during the spring period. Although 292 habitat units would be gained by these seasonal closures, only a portion of these—about 60 habitat units—would be included in habitat replacement calculations. Including the 215 habitat units gained by year-round closures, road closures would contribute about 275 habitat units toward habitat replacement. The remaining 507 habitat units would be replaced by

Noranda through land acquisition. Effects from road closures on recreational users, mining claimants, and private landowners were discussed under Noranda's mitigation plan in Alternative 1.

Habitat acquisition. As with Noranda's proposal, a Management Committee would be established to administer the compensation program. Noranda would purchase private lands or conservation easements on private lands that would have an equivalent or better habitat value when compared to the remaining habitat needed for compensation (507 habitat units). The acquisition would be completed within 6 years of construction startup, with at least half completed within the first 3 years. Affected habitat units include both those physically disturbed by the project and those within influence zones of surface activities. Noranda would compensate for habitat units physically disturbed by purchasing lands or conservation easements. This would account for approximately 132 habitat units. Noranda would compensate for the additional 375 habitat units by either purchasing private lands or obtaining conservation easements. The title or easement could either be retained by Noranda, or it could be transferred to an agency or private group, as discussed in Chapter 2.

At the end of the project and reclamation period, Noranda would retain the right to offer purchased lands for sale to a private trust or to the U.S. Forest Service. Noranda would provide the Forest Service 'first-right-of-offer' before offering fee title of acquired lands to third parties. These lands would remain undeveloped and/or managed for bear habitat. This measure is needed to ensure that the lands do not become a mortality sink for grizzly bears.

At the USFS' discretion and following reclamation, Noranda would transfer fee title to the USFS any mill sites patented in conjunction with the Montanore Project. When Montanore Project operations cease, Noranda would transfer to the USFS surface title of HR133 and HR134 (Noranda's claims in the Cabinet Mountains Wilderness), if Noranda successfully patents these claims. This would prevent future development of these lands.

In summary, the agencies' plan would mitigate and compensate for the direct and indirect effects on grizzly bears. Road closures would provide immediate secure displacement areas to mitigate effects during construction and operation. Human-bear interaction would be minimized by specific actions to limit traffic amounts and speed and to reduce bear attractants. Increased law enforcement would act as a deterrent to illegal shooting of bears. Public support for grizzly bear recovery efforts would be bolstered by the newly created information and education position. Habitat acquisition would replace habitat physically disturbed by the operation and, along with road closures, would compensate for affected habitat within influence zones of project activities.

Under Alternatives 2 and 3, the KNF would amend the Forest Plan for about 130 acres surrounding the Libby Creek Recreation Gold Panning Area. The area would be changed from MA 14 to MA 6. This change would accommodate construction of developed recreational facilities. It would not affect the space available for the grizzly bear; most of the 130 acres is currently considered unavailable since the area is in a road influence zone.

CUMULATIVE IMPACTS

Cumulative impacts are similar for all action alternatives. ASARCO's Rock Creek Project combined with the Montanore Project would result in an estimated 2.7 percent population increase in Lincoln and Sanders counties. This population increase would result in a proportional increase of indirect impacts described for Alternative 1. The Rock Creek Project, if approved, would affect an about 640 acres of additional space in BMU 5 and cause a constriction of grizzly bear habitat between the two mines. The bottleneck effect caused by this constriction may accelerate habitat fragmentation, which continues to be a major threat to the very narrow linear ecosystem comprising the Cabinet

Mountains Wilderness. The constriction also could interfere with north-south grizzly bear movements, resulting in more human-bear interactions and increased bear mortality risk. An analysis and EIS is currently being prepared for the proposed Rock Creek Project. The specific effects of the proposed operation and alternatives have yet to be determined.

Small-scale mineral exploration and mining projects have been conducted historically within the affected bear management units. These projects are expected to continue over the life of the Montanore Project. These operations usually involve minimal amounts of surface disturbance and result in limited potential effects on grizzly bears, other wildlife, and bear and other wildlife habitat. No large-scale mineral exploration or mining activities, other than the ASARCO Rock Creek Project and associated activities, has been proposed with the affected bear management units. Such activities, however, could occur at some time during Montanore Project operations. All proposed future mineral projects would require site-specific review of potential effects to grizzly bears and other wildlife species.

Proposed timber sales during the next ten years would convert 1,650 acres of timber currently used for big game cover to areas which would provide better big game foraging opportunities, at least until canopy closure. Road construction and use and logging activities would reduce big game habitat up to 0.25 miles from these activities during daylight hours. These reductions in habitat use would remain relatively constant as old timber sales are completed and new sales begin. Roads are closed in old timber sales as needed to maintain forest road density standards. Increased forage availability in completed sale areas may partially offset some loss of use due to new sales.

RESOURCE COMMITMENTS

Habitat disturbance and displacement would increase animal numbers in areas not affected by the project, increasing competition for food. Some species, such as mule deer or elk, may eventually return to disturbed areas or use nearby habitat during project operation. After mine closure, wildlife would slowly return to the mine areas, as vegetation cover and production returns to pre-mine levels. The reduced vegetation production would be an irretrievable commitment of resources. The grizzly bear would incur an increased risk of mortality and temporary displacement. Any mortality to big game or the grizzly bear related to the project would be an irretrievable commitment of resources. Any increased mortality risk that remains following operations would be an irreversible commitment of resources.

ALTERNATIVE 7

Disturbance of wildlife habitat and wildlife displacement described under the six action alternatives would not occur.

OLD GROWTH HABITAT

SUMMARY

Construction of mine-related facilities proposed as part of Alternatives 1, 2, and 3 would disturb about 192 acres of protected old growth habitat. Most of the disturbance would occur in the tailings impoundment area. Under Alternative 1, the transmission line would require tree clearing on about 50 acres of old growth habitat; fragmentation would affect about 80 additional acres. Total effects on protected old growth from clearing and fragmentation total 202 acres for Alternative 4, 140 acres for Alternative 5 and 155 acres for Alternative 6. No old growth habitat would be affected by Alternative 7.

ALTERNATIVES 1, 2, AND 3

Construction of mine-related facilities proposed as part of Alternatives 1, 2, and 3 would disturb about 192 acres of protected old growth habitat. Old growth in project area is shown on Figures 3-10 and 3-11 in Chapter 3. All affected stands for the mine surface facilities and access roads would be in the Libby Creek timber compartment. Additional effects on old growth habitat would also occur, depending on the transmission line alternative selected. Widening the existing Bear Creek road would impinge on the edges of two old growth stands resulting in the disturbance of less than 2.5 acres. Because this disturbance would be associated with an existing road corridor, and the road alignment only skirts the edges of the affected old growth stands, there would be little loss of habitat value. Land application disposal area No. 2 would result in the direct disturbance of about 20 acres of old growth habitat, with the fragmentation and associated loss of habitat value of about another 7 acres. Land application disposal area No. 1 would entail about a 2-acre old growth disturbance, with little, if any, associated habitat value loss. The Ramsey Creek plant site would disturb about 5 acres of old growth, with less than 5 additional acres degraded as a result of stand fragmentation.

The most significant disturbances of old growth habitat would result from constructing the tailings impoundment and road from the impoundment to the plant site. The proposed tailings impoundment site would remove about 132 acres of old growth habitat. The road between the impoundment and the plant site would directly disturb about 16 acres, given a nominal construction right-of-way width of 50 feet. This disturbance would be closely associated with disturbance from the transmission line corridor and the Ramsey Creek plant site itself, resulting in additional losses due to fragmenting an existing old growth stand which is long and narrow. The value of old growth habitat throughout this corridor would be largely lost.

Under Alternative 1, the transmission line would require tree clearing on about 193 acres of timberland. Of the total tree clearing, 50 acres would be old growth habitat. Total ground disturbance from access roads, crawler tractor trails, and tower site construction would be 128 acres, including 105 acres on the right-of-way and 23 acres off the right-of-way. In addition, the right-of-way would cross 24 acres where timber has been harvested previously.

One-quarter mile southeast of Howard Lake, the line would pass through a 30-acre stand of old growth, bisecting the stand into two fragments of approximately 22 acres to the west and 8 acres to the east. Besides the right-of-way clearing, there would be 1 acre of ground disturbance.

One-quarter mile north of Howard Lake, the transmission line would cross a 32-acre old growth stand, cutting off a 3-acre fragment on the northeast. This fragment would not maintain its value as old growth habitat.

Near the confluence of Libby and Howard creeks, this route would create a 10-acre fragment to the south. This fragment is presently crossed by a road, and would sustain another acre of ground disturbance. The additional edge effects of light, temperature, and wind could make these fragments unsuitable as old growth habitat.

The lower slopes of the ridge between Libby and Ramsey creeks contain a large complex of old growth habitat stands which extend up the Ramsey Creek drainage (see Figure 3-10 in Chapter 3). The complex was created by several clearcuts that dissect the area into stands connected by narrow strips. The transmission line route would cut across the southernmost strip between the main stand and another to the northeast. The effectiveness of this strip is reduced by the presence of clearcuts on either side and would be further degraded by the right-of-

way. The two stands are large enough to maintain their value as old growth habitat, although the indirect effects of the transmission line would reduce the size of these areas due to the loss of the connecting strip.

Closer to Ramsey Creek, the centerline route would cross a large clearcut and then cut through more old growth habitat (Figure 3-10 in Chapter 3). More than 2 acres of ground disturbance would occur in this section. The fragments that would be created are large. The acreage to the north is irregularly shaped and bordered by clearcuts. A narrow strip of trees connects this acreage to an old growth stand to the northeast. Because of the corridor connections, the proximity of the stands, and their size, both acreages should retain their value as old growth habitat.

IMPACTS COMMON TO ALL TRANSMISSION LINE ALTERNATIVES

Clearing old growth habitat for the transmission line and access roads has potential for indirect effects. Such effects include fragmentation of habitat. Fragmentation of old growth stands, particularly in areas where stands would be 50 acres or less, is discussed by transmission line alternative. It is difficult to predict completely the effects of fragmentation since the minimum "survivable" stand size varies with site-specific geographic and climatic conditions.

The DNRC and the KNF assumed the area to be cleared would be wide enough to allow the conductors to swing in the wind and not come within flashover distance of any vegetation. A minimum 100-foot-wide right-of-way width was used for this impact analysis except in old growth habitat, where, because of taller trees requiring more clearing, the width is assumed to be 200 feet (to avoid falling trees). The DNRC would ask the Board for authority to work with the KNF and Noranda to locate structures and minimize clearing where possible in the sensitive areas identified on Figure H-1, within the limits of the Board-approved centerline.

The rest of the route up Ramsey Creek would closely parallel the Ramsey Creek road and is common to all alternatives. The road would be widened for the mine access, and the area would accommodate additional mine facilities, including the tailings pipelines, and a smaller electrical line to the tailings impoundment site. The clearing required for all these facilities would reduce old growth habitat to a narrow strip along most of the north side of the road. The old growth habitat value where the stand is narrow would be largely lost (Figure H-1 in Appendix H).

ALTERNATIVE 4

Alternative 4 would require tree clearing on about 203 acres of timberland. Of the total tree clearing, 61 acres would be old growth habitat. Clearing and the resulting fragmentation would affect an estimated 202 acres of protected old growth within the Libby Creek timber compartment. An additional 30 acres of right-of-way would cross areas where timber has been clear-cut. Total ground disturbance, primarily from access road and tower site construction, would be 50 acres, including 32 acres on the right-of-way and 18 acres off the right-of-way.

One-quarter mile southeast of Howard Lake, the line would pass through a 30-acre stand of old growth, bisecting the stand into two fragments of approximately 19 acres to the west and 12 acres to the east. Besides the right-of-way clearing, a pull site and road construction would require over 2 acres of ground disturbance off the right-of-way in the old growth stand. The eastern fragment is already crossed by a road. Increased light, wind and temperature along the edges of these fragments would reduce the effective size of the habitat within the fragments even further, and could eliminate present old growth characteristics in the stand.

One-quarter mile north of Howard Lake, the transmission line would cross a 32-acre old growth stand, cutting off a 3-acre fragment on the northeast. This fragment would not maintain its value as old growth habitat.

Near the confluence of Libby and Howard creeks, this route would bisect another old growth stand into two 14-acre fragments. The southern fragment is presently crossed by a road. The additional edge effects of light, temperature, and wind could make these fragments unsuitable as old growth habitat.

The lower slopes of the ridge between Libby and Ramsey creeks contain a large complex of old growth habitat stands which extend up the Ramsey Creek drainage (see Figure 3-10 in Chapter 3). The complex was created by several clearcuts that dissect the area into stands connected by narrow strips. The transmission line route would cut across the southernmost strip between the main stand and another to the northeast. The effectiveness of this strip is reduced by the presence of clearcuts on either side and would be further degraded by the right-of-way. The two stands are large enough to maintain their value as old growth habitat, although the indirect effects of the transmission line would reduce the size of these areas due to the loss of the connecting strip.

Closer to Ramsey Creek, the centerline route would cross a large clearcut and then cut through more old growth habitat (Figure 3-10 in Chapter 3). The fragments that would be created are large. The acreage to the north is irregularly shaped and bordered by clearcuts. A narrow strip of trees connects this acreage to an old growth stand to the northeast. Because of the corridor connections, the proximity of the stands and their size, both acreages should retain their value as old growth habitat.

ALTERNATIVE 5

Alternative 5 would require tree clearing on about 183 acres of forest. Of the total tree clearing, 46 acres would be in old growth habitat. Clearing and the resulting fragmentation would affect an estimated 140 acres of protected old growth within the Libby Creek timber compartment. No additional tree clearing is expected on 38 acres of right-of-way in areas that have been clear-cut. Total ground disturbance from access roads and tower site construction would amount to 46 acres, including 26 acres on the right-of-way and 20 acres off the right-of-way.

Alternative 5 would follow the same route as Alternatives 1 and 4 from Sedlak Park across the Fisher River and along Miller Creek for just over 3 miles. Alternative 5 then would diverge to head northwest up a tributary drainage onto a ridge spur, and then crest the ridge. The angle point and access road on this spur would be located near a stand of very large ponderosa pine and western larch. This area exhibits good habitat qualities for the pileated woodpecker. The angle point placement and road design would be adjusted during final design to avoid or minimize clearing trees important to the woodpecker. Review and approval by DNRC and KNF of plan and profile maps and proposed tree clearing would be followed by monitoring of construction in the area.

Near the confluence of Libby and Howard creeks, the route would cross an old growth stand, fragmenting it into a 20-acre parcel to the south and a 9-acre narrow band to the north. Edge effects would be particularly severe in long narrow stands, and it is unlikely that the northern fragment would retain its value as old growth habitat.

Alternative 5 would follow the same route up Ramsey Creek from the Howard-Libby creek confluence as Alternatives 1 and 4, so the old growth impacts in this area would be the same as described for Alternative 4.

ALTERNATIVE 6

The Swamp Creek route would require clearing on about 200 acres of forest. Of this, 74 acres would be removed from known areas of old growth habitat. Clearing and the resulting fragmentation would affect an estimated 255 acres of protected old growth. Most of the protected old growth would be within the Libby Creek timber compartment (140 acres), while the remainder (15 acres) would be within the Horse

Mountain Compartment. An additional 46 acres of right-of-way would cross areas of clear-cut timber harvest. Ground disturbance would total 42 acres, including 29 acres on the right-of-way and 13 acres off the right-of-way.

The Swamp Creek alternative would cross the Fisher River 1/2 mile north of the other alternatives. On the west side of this crossing, the line would pass by a stand of very large ponderosa pine and western larch adjacent to an oxbow pond. Some of these trees would have to be cleared. These trees are prime habitat for pileated woodpeckers, the KNF's old growth indicator species.

Besides the clearing at the Fisher River, riparian vegetation would be removed along Libby Creek near its confluence with Howard Creek, and from ten intermittent drainages. This alternative would cross Libby and Howard creeks in the same place as Alternative 5, so the impact there would be the same as described under the North Miller route.

On the north side of the ridge between Swamp Creek and Schrieber Creek, the proposed route would cross a stand of old growth habitat, creating a 26-acre fragment to the south. This fragment may lose its value as old growth.

One-quarter mile farther west the line would pass through another old growth stand, cutting it into two fragments. Both fragments would be connected by a narrow strip to larger fragments. These connections would help the fragments retain their value as old growth.

The route would continue southwest for about a mile, where it would meet and coincide with Alternative 5. The impacts beyond that point would be the same as those described for Alternatives 4 and 5, starting from the old growth stand at the confluence of Libby and Howard creeks.

CUMULATIVE IMPACTS

Old growth habitat would be reduced by development of the Montanore Project. Over 10 percent protected old growth would remain. Therefore, no reassignment of land would be required to maintain the minimum old growth standards contained in the Forest Plan, unless transmission line Alternative 4 were selected with mine alternatives 1, 2, or 3. The ASARCO Rock Creek Project would not affect old growth habitat in the Libby Creek or Horse Mountain timber compartments. Timber sales within the two timber compartments would not affect protected old growth without a future evaluation and reassignment per provisions of the Forest Plan.

RESOURCE COMMITMENTS

Old growth habitat affected by the tailings impoundment would be irreversibly lost. It is unknown if old growth habitat affected by other project components, such as the land application disposal area, and the transmission line, would be affected permanently.

ALTERNATIVE 7

No effects to old growth habitat would occur.

SOILS, VEGETATION AND RECLAMATION

SUMMARY

Under Alternative 1, the Montanore Project would result in the disturbance of about 1,270 acres. Impacts to soils and vegetation would be limited to areas used for surface facilities and transportation and transmission line corridors. As part of Noranda's reclamation plan, soil would be stripped from most areas to be disturbed. Most salvaged soil would be stockpiled in

revegetated stockpiles. During final reclamation, stockpiled soil would be redistributed on disturbed areas and revegetated. Prolonged stockpiling of soils would have some adverse impacts. With successful revegetation, long-term impacts to vegetation and soils resources would be negligible.

At the KNF's discretion, the Bear Creek Road would be returned to its pre-mine width and the disturbance associated with the road reclaimed under Alternatives 2 and 3. Alternative 3A may result in no surface disturbance at the proposed land application disposal area and decreased soil erosion. Alternatives 4, 5, and 6 would have significantly less road construction and associated soil erosion than Alternative 1. Surface disturbances would not occur under Alternative 7.

ALTERNATIVE 1

Vegetation Production and Diversity

Successful implementation of the reclamation plan would result in the re-establishment of a viable, self-perpetuating forest ecosystem on most disturbed land. Revegetation would not result in the restoration of native vegetation habitats. In time, however, reclaimed areas would become, in most ways, indistinguishable from surrounding undisturbed areas. Factors affecting this would include invasion of reclaimed areas by species from undisturbed areas and the rate of vegetation community succession. Fire, disease and management would also affect the post-mining vegetation.

Although reclamation of the tailings impoundment would result in reforestation, future harvesting of timber would not be allowed in order to protect the long-term integrity of the impoundment. If timber harvesting were restricted on all disturbed areas associated with the impoundment, nearly 1,000 acres of potential commercial timber stands would be lost. Upon reclamation, however, this land would be productive as wildlife habitat (see *Land Use* and *Wildlife* sections).

Revegetation may not be successful on all disturbed areas. Revegetation may fail where—

- topsoil is absent, as on cut slopes;
- soils are deeply compacted;
- slopes above access roads fail;
- traffic on access roads after revegetation crushes seeded plants and compacts soils; or
- soils erode before vegetation becomes established.

The first four situations could cause localized revegetation failures anywhere along the transmission line or mine access roads. Soils along the transmission line corridor are most likely to erode near the Fisher River, the headwaters and lower stretch of Miller Creek, and the area between Howard Lake and Libby Creek. Prior to vegetation reestablishment, the embankment face probably would erode. Simple reseeding might establish vegetation on some failed areas, while other areas might need slope or soil stabilization before reseeding. Steep slopes with inadequate topsoil may never adequately support vegetation.

Threatened, Endangered or Sensitive Species

No threatened or endangered plant species have been found along Little Cherry Creek or elsewhere in the project area. Populations of the northern beechfern have been documented along Little Cherry Creek. The northern beechfern has been identified by the Regional Forester as a sensitive species due to a combination of rarity and limited distribution within the Northern Region, and potential habitat loss. The northern beechfern is classified by the Montana Natural Heritage Program as secure globally, but imperiled in Montana because of rarity or other factors.

Construction of the proposed tailings impoundment and diversion of Little Cherry Creek would unavoidably destroy the entire population of northern beechfern along Little Cherry Creek. Approximately 5 wool-grass plants (another sensitive species) would also be eliminated by the proposed project. Below the diversion dam, surface flows from springs and seeps would probably be reduced by Noranda's proposed pressure relief/seepage interception system. As a result of the diversion and seepage interception, the vegetation community in Little Cherry Creek would change. The area probably would no longer provide adequate moisture for the habitat of the northern beechfern. The Little Cherry Creek population constitues about 25 percent of the known northern beechfern populations on the KNF.

Noranda has proposed a mitigation program for the northern beechfern (see Chapter 2). Transplantation may not be an effective approach as a conservation technique (Fahselt, 1988). Although transplantation has been proposed as an acceptable conservation strategy (IUGN, 1986), the Canadian Botanical Association developed a policy statement that discourages the use of transplantation as a conservation technique. There are many examples of unsuccessful transplantation attempts (Lape, 1985; Morton, 1982; Cranston and Valentine, 1983).

Soil Productivity

Soil impacts are closely related to vegetation impacts. Impacts to the soils resources would be unavoidable, but these impacts could be minimized with proper reclamation and resource management. Given successful reclamation, long-term impacts to soils would be minimal.

Impacts to soils would include erosional losses, destruction of natural soil profiles and other physical alterations, and reduction in biological activity. Erosion control measures have previously been discussed. The most important aspect in minimizing other physical impacts would be to minimize soil compaction during reclamation. Vegetation will not thrive in compacted soils. Once vegetation is successfully established, natural soil forming processes would slowly begin to re-establish soil profile development.

Soil fertility can be managed in the short-term with inorganic fertilizers. In the long-term, re-establishment of natural nutrient cycling ability of the soil would mitigate a temporary decrease in soil productivity resulting from stockpiling of soils. Stockpiling would also result in the reduction of viable biological soil components, including seeds, plant roots capable of growth, and beneficial micro-organisms. With successful vegetation establishment and post-reclamation management, the biological activity of the soil would be eventually restored.

Soil Erosion

The control of soil erosion would be important during operations and during final reclamation. Erosion impacts may include deterioration of air and surface water quality, addressed in detail elsewhere in this chapter. Other impacts include soil loss and more difficulty in revegetation.

Most of the soils suitable for reclamation formed in volcanic ash, and are typically high in silt content. These soils are moderately susceptible to wind and water erosion. Increased rates of soil erosion relative to natural erosion rates would result from soil salvage and replacement operations. During operations, soil loss and sediment yield would be mitigated several ways. First, mixing of salvaged soils would increase rock fragments on the soil surface. Rock fragments lower susceptibility to erosion by increasing the amount of surface cover provided by rock. Disturbed soils would then be further stabilized by interim revegetation measures. Finally, diversion structures, and other drainage and sediment control structures would control surface flows and reduce sediment yields.

Transmission line impacts. Minor to moderate soil compaction would occur as a result of constructing

the transmission line, substations and microwave repeater station. Soil compaction can result in decreased water infiltration and poorer soil aeration. Seedling emergence can also be reduced by compaction. Most soil compaction results from the first two or three passes of heavy construction equipment. The degree of soil compaction depends on soil moisture, texture, and amount of plant root mass in soil. Noranda would till soils prior to revegetation. Deep tillage (or ripping) would reduce compaction on deeply compacted temporary road surfaces.

Rutting would likely occur if construction were to take place when fine-grained soils are wet. Some soil loss due to erosion would also occur during transmission line construction. Revegetation following construction would minimize long-term erosional losses.

Certain natural conditions would pose constraints in the design and construction of the transmission line. Proper attention during line design would avoid problems such as slope instabilities on road cuts and inadequate structural support on fine-grained soils low in bearing strength.

Figure 4-1 shows the location of each alternative transmission line route. The amount of surface disturbance from road construction and stringing operations for each alternative transmission line route is shown in Table 4-34. Alternative 1 would result in more ground disturbance and increased soil erosion than any of the other alternative alignments. Alternatives 4, 5 and 6 would entail the use of helicopters for stringing, thus reducing surface disturbances from transmission line construction.

From the Sedlak Park substation, all identified alternatives coincide as they extend north approximately 4 miles along the Fisher River. Much of this segment is located on steep sideslopes in highly erodible lacustrine silts and clays. A logging road is located near the proposed alignment, but would not provide access to all structures. There would not be adequate access along the centerline for

Table 4-34. Estimated miles of roads and number of stringing sites for the alternative routes.

Slope range	Alternative† 1	Alternative 4	Alternative 5	Alternative 6
	—miles of new roads crossing highly erodible land types—			
0-10%	0.00	0.00	0.00	0.00
11-20%	1.02	0.27	0.27	0.22
21-40%	1.17	1.29	1.10	0.80
41-55%	1.33	0.06	0.06	0.00
>55%	0.61	0.00	0.00	0.00
	—miles of new roads crossing other land types—			
0-10%	0.00	0.00	0.00	0.00
11-20%	1.36	1.25	0.80	0.70
21-40%	6.61	3.77	2.69	3.13
41-55%	1.25	0.88	1.74	1.21
>55%	1.78	0.21	0.11	0.00
Total	15.13	7.73	6.76	6.05
Assumed stringing sites	7	7	8 to 10	7 to 8

Source: Department of Natural Resources and Conservation. 1992.
†Assumes use of crawler tractor during line stringing operations.

the stringing operation, and additional grading along the line would be required. The potential for erosion is considered moderate to high where new road and line stringing access would be needed on the steep sideslopes. Erosion potential would be low for structures on the nearly level valley floor and where existing access is adequate.

The last two or three structures where the line turns to cross the Fisher River and U.S. 2 would be located on slopes of about 60 percent. Successful revegetation on these slopes would be critical to reducing soil erosion. Line stringing could require a leveled area up to 150 feet by about 50 feet. Smaller disturbance would result if a turn-out on the haul road could be used for stringing operations.

From the Fisher River crossing to the divergence of the North Miller route (Alternative 5), the route crosses the base of south-facing slopes in two areas with highly erodible silts and clays. Slopes along this segment range from nearly level to over 40 percent, but most are less than 20 percent. New access roads would be built to about five of the 18 structures in this portion of the route. Line stringing by crawler tractor would require a leveled surface on a sideslope for about 0.7 mile. Temporary access roads would be subject to increased soil erosion until vegetation is re-established.

The steepest terrain is located in the head of the Miller Creek drainage. Existing roads would be used for access to only three of 23 structures along the portion of line from the bottom of Miller Creek over the divide to a point 0.25 mile southeast of Howard Lake. A graded trail would be required for line stringing over most of this segment because the sideslopes exceed ten percent. Soils at the lower elevations in Sections 21 and 22, T27N R30W, are easily eroded and prone to landslides. Increased erosion would result from access road construction for line construction and stringing operations. Total access requirements for stringing tractor on slopes greater than 10 percent is estimated to be 7.59 miles.

From Howard Lake to the Libby Creek crossing, the proposed alignment would cross sideslopes in the 10 to 40 percent range. Existing roads would provide access to about nine of 19 structures. Access road spurs would have to be constructed to at least five and as many as nine of the remaining structures, increasing the possibility of erosion.

All alignment alternatives coincide between the crossing of Ramsey Creek and the mine site. This segment would be located mostly on slopes of less than 40 percent. The existing Ramsey Creek road would provide access to all but four of the structures. Leveling would probably be required on sideslopes greater than 10 percent for line stringing, and this excavation would result in some soil loss.

Reclamation

The stated long-term objective of Noranda's proposed mine reclamation plan is "to establish a post-operational environment that is compatible with existing and proposed land uses of the area...consistent with the [Kootenai National] Forest Plan." Specific goals of the reclamation plan include—

- re-establishment of biological potential suitable for supporting vegetative cover appropriate to the area;
- restoration of wildlife habitat; design of a land configuration compatible with the watershed; and
- re-establishment of an aesthetic environment allowing for visual quality and recreational opportunity.

Mine facilities. Noranda has committed to salvaging and replacing soils on most disturbed areas in the mine area. Soils would not be salvaged and replaced for the mine access road and facility corridors or at proposed soil stockpile areas (see Chapter 2). Enough soil would be salvaged to ensure successful reclamation.

Disturbed areas would be graded to achieve planned post-mining topographic configuration and drainage patterns. Stockpiled topsoil would be redistributed onto graded areas. Applied fertilizer would be

incorporated into the soil by tillage as part of seedbed preparation. On slopes too steep for tillage equipment, fertilizer and mulch would be sprayed on in a liquid slurry. Soil tests would be conducted on regraded soils to determine fertilization requirements.

Although the use of inorganic fertilizers can compensate for decreased natural fertility in stockpiled soils, too much fertilizer can depress the re-establishment of biologically catalyzed nutrient cycling, creating an unwanted fertilizer dependency in newly established vegetation. Fertilization might also favor establishment of certain non-native grass species over native species. It is difficult to predict these types of responses reliably.

Two revegetation species mixes have been developed (Tables A-1 and A-2, Appendix A). Both mixes would be intended to result in a coniferous forest vegetation type with an understory of shrubs, grasses and forbs. One mix would be specifically intended for cool, moist sites; the other would be more broadly adaptable to most other growing conditions. Each mix would contain both native and non-native species.

Seed would be drilled on prepared sites at a rate of 90 to 100 pure live seeds per square foot. This rate would be doubled for broadcast seeding on steeper slopes. With adequate moisture, these mixtures sown at these rates would be expected to produce a fairly rapid establishment of herbaceous cover. Woody species would be planted in densities averaging over 600 plants per acre, in proportions of about 70 percent tree species and 30 percent shrub species. Noranda anticipates achieving a 65 percent survival rate for trees after 15 years. Woody species would be planted in a relatively even density in some areas and in denser islands or clusters in other areas. Selection of areas for varied planting densities of woody species would enhance landscape diversity.

Monitoring and management of revegetated areas following revegetation would be essential to successful project area reclamation. Noranda's monitoring plan (Chapter 2) would be adequate to determine the effectiveness of the revegetation plan.

Noranda has proposed increasing the width of the present Bear Creek Road and two other roads up to 29 feet. This widening would require suitable road base. Noranda has not developed detailed plans for procuring this material; studies are proposed to evaluate the material in the proposed borrow area at the tailings impoundment site. If additional disturbance is required to obtain this material, Noranda would have to conduct additional environmental studies and the agencies would complete additional environmental analysis and documentation.

Tailings impoundment. Immediately after cessation of tailings deposition, the surface of the impoundment would most likely be comprised of a relatively firm and dry tailings sand beach, a relatively soft and saturated slimes surface, and an area of pond water toward the back of the impoundment (decant pond) (Vick, 1983). For the proposed reclamation and stabilization efforts (such as regrading, placing topsoil and revegetation) to be accomplished, the entire impoundment surface must be sufficiently firm to support the necessary equipment. The amount of drying time necessary to achieve this degree of firmness would vary greatly over the impoundment surface, depending on the nature of the tailings, size of the pool and climatic conditions. Surfaces composed of coarse tailings sands may be sufficiently dry and firm within several days, whereas zones of slimes may require a drying period lasting a year or more, especially in the vicinity of the decant pond. Drying of the decant pond would be accomplished via drainage and evaporation.

Consolidation and settlement of the tailings would occur as excess pore water pressures within the tailings are dissipated (Nelson et al., 1983). Continuing drainage of the tailings would result in lowered water content and pore water pressure. Consolidation could also be accelerated by placement of a relatively

thick cover comprised of compacted soil or mine waste materials. Settlement of the coarser tailings zones would occur quite rapidly since excess pore pressures dissipate quickly in these materials. However, desiccation and consolidation of the slimes surface may require considerable time. Studies by Krizek et al. (1977) involving 2- to 3-meter thick (6.6 to 9.8 feet) surficial layers of dredged fill indicated that settlements of about 0.2 to 0.4 meter (0.7 to 1.3 feet) required about 250 days. Complete consolidation of the slimes would probably take several months to several years, depending on the vertical thickness. Noranda conducted two consolidation tests on artificially sedimented samples of tailings slimes produced from a pilot grind of Montanore ore. The samples were sedimented from slimes slurry having a solids content and gradation representative of the proposed project tailings slimes. Results of these consolidation tests indicate the tailings slimes would consolidate under applied loads. Based on the test results, it is expected that a significant fraction of the total consolidation settlement probably would occur during impoundment filling, as the tailings consolidate under the weight of the overlying tailings. Noranda would conduct detailed settlement analyses prior to final facility design, and the results of these additional analyses would be incorporated in the reclamation grading plans for the impoundment. Maximum consolidation settlements of the tailings surface are anticipated to be about 10 percent of the vertical thickness, ranging from a few inches at the impoundment edges to between 20 and 30 feet at the thickest deposit.

Without adjustments to the tailings surface during reclamation, direct precipitation and resulting runoff on the impoundment surface and runoff from the limited watershed above the impoundment would tend to collect in the decant pond area. If the surface remains unaltered, this former pond area would be concave and a continual recharge point for the impoundment. Because of the heterogeneous nature (both horizontally and vertically) of the tailings deposit, differential settlements of the impoundment surface would probably occur, resulting in minor surface undulations and localized ponding of direct precipitation and any runoff impacting the surface. However, the magnitude of recharge and resaturation of impounded tailings resulting from this localized ponding would be very small when compared to the recharge via runoff concentrating within the decant pond area depression.

The initial reclamation efforts proposed by Noranda are directed toward minimizing the quantity of surface runoff impacting the pond area by grading the impoundment surface to drain direct precipitation and runoff. Contouring and regrading of portions of the tailings surface would prevent the collection of surface runoff in the pond area. Contouring of the surface would also serve to minimize the small amount of recharge occurring within localized areas subjected to differential settlements. Noranda proposes to cover certain areas of the impoundment with waste rock as needed to improve trafficability for equipment prior to topsoil replacement. Adequate waste rock would likely be available from adit construction and mine development. Where the tailings surface is sufficiently firm to support equipment, topsoil would be applied directly to the tailings surface.

The contouring and regrading activities proposed by Noranda could be accomplished in an incremental fashion as areas of the impoundment become accessible by equipment. Each area would be graded and contoured to promote drainage of surface runoff to the impoundment perimeter. Topsoil would be placed on each area and revegetated.

Acid formation is not expected to adversely affect reclamation efforts. Although the ore body contains a small percentage of sulfides, analyses conducted by Noranda indicate that tailings would not be acid forming. Noranda proposes to conduct additional testing of tailings and waste rock prior to reclamation.

A 24-inch thick soil cover would be placed on the tailings impoundment dam; 18 inches would be used

on the impoundment surface. Tests indicate that coarse tailings underlying the soil cover would be physically and chemically suitable as a plant growth medium. If additional analyses of the tailings physical and chemical characteristics confirm the baseline analyses, long-term revegetation success would be expected.

Transmission line. Existing vegetation would be removed for construction of access roads, for leveling working areas near sites, for pole installation or line stringing, for possible trenching to install counterpoise ground wire, and for grading sideslopes for the bulldozer path to string conductors (see Table 4-26, *Wildlife* section, for acres of coniferous forest affected). Vegetation removal and grading may not be required on level or gently sloping ground or where an existing road can be used. Limited topsoil removal may occur during access road construction. Topsoil would be placed alongside the road cut. Some road building in steep terrain would likely be required. Where cut-and-fill slopes would be required on steep slopes, these areas would not be covered with topsoil. Noranda has proposed using the Board of Natural Resources and Conservation's environmental specifications found in Appendix F.

Weed invasion and control. The disturbed soils created by construction activities would provide favorable sites for spotted knapweed, Canada thistle, and St. Johnswort. Canada thistle also might invade cleared areas. The seeds and other reproductive parts of these weeds could cling to construction vehicles and be spread along the transmission line and access roads.

The spread of weeds is unavoidable; enforcement of or compliance with the County Noxious Weed Control Act would help to limit the spread. Where project facilities disturb Champion land, either Champion or Noranda would be required to prevent weeds from propagating or going to seed or to develop an effective weed control plan, subject to the county weed board's approval. Under the terms of the transmission line right-of-way agreement, Champion could choose to hold Noranda responsible for weed control. Noranda would be responsible for preventing weeds from propagating or going to seed or developing an effective control plan for land it disturbs within the national forest.

Weed control plans submitted to the weed board also require agencies' approval. If the plans are not approved by the agencies, the agencies can require separate plans for weed control. After the transmission line is built, agency and weed board representatives would monitor weed infestations. If necessary, the weed control efforts would be modified or intensified.

Implementation of the revegetation plan and early detection of infestations and treatment would be key elements of Noranda's weed monitoring and control program on private land. All herbicide applications would be made in accordance with approved materials and methods under the supervision of licensed applicators as required by law. Effective management of a weed control program as proposed by Noranda would minimize weed infestation on land disturbed by mining. Use of herbicides on KNF land would require more specific information and additional environmental analysis.

ALTERNATIVE 2

Noranda would continue to fund broad-scale inventories for northern beechfern on the KNF, to assess its status more accurately. The inventories would continue until the KNF deems the inventories sufficient. The KNF would develop a conservation strategy based on the accumulated field survey information. As part of this conservation strategy, the KNF would provide permanent protection for other known beechfern populations on the Forest. The number of populations protected would be determined in the conservation stategy. Although some transplanting could be conducted as part of an experimental program, transplanting would not be included as mitigation or compensation for the

project. The effects of Alternative 2 on the northern beechfern population in Little Cherry Creek would be the same as Alternative 1.

At the KNF's discretion, Noranda would institute a sampling program to monitor acid formation from the waste materials. This would entail analysis of waste rock and tailings to determine and monitor acid-base potential. These materials also would be sampled periodically during project operations, if appropriate, to ensure that acid problems would not develop. Appropriate treatment measures would be taken as required in accordance with monitoring results. This measure would ensure acid-generating materials would not affect surface or ground waters or adversely affect revegetation.

The Bear Creek Road from U.S. 2 and the Bear Creek Bridge would be returned to its pre-mine width, depending on the future needs of the KNF. The 22-acre disturbance associated with the road would be reclaimed.

ALTERNATIVE 3

Noranda would treat some or all excess water prior to discharge. Under Option A, the land application disposal areas may not be constructed, reducing the amount of disturbed area. Alternative 3C would require use additional LAD areas in the tailings impoundment area. Increased erosion and sedimentation could occur from these areas if spray irrigation is used.

Acid rock drainage potential would be sampled and monitored, as with Alternative 2, and the Bear Creek road would be returned to its pre-mine width. Other impacts described under Alternatives 1 and 2 would occur.

IMPACTS COMMON TO ALTERNATIVES 4, 5 AND 6

Proper attention during line design would minimize or avoid problems such as slope instabilities on road cuts and inadequate structural support on fine-grained soils with low-bearing strength. DNRC's Environmental Specifications, as proposed, would minimize these impacts to the extent possible. All routes would cross areas with slopes greater than 30 percent. Where practical, access roads would be located to avoid steep terrain; however, crossing of some steep areas by the line and roads would be unavoidable. Road construction in steep areas would cause greater land disturbance and result in greater potential for soil erosion than on level or gently rolling terrain. Areas that would have greater potential for soil erosion have been identified for alternatives 4, 5, and 6. These areas are listed in Appendix H. Most problems can be minimized with the Best Management Practices proposed by the agencies and Noranda. Additional limited authority for the DNRC as described earlier in the *Surface Water Hydrology* section would be used to ensure that measures are the best available for the situation.

Figure 4-6 shows the centerline of each alternative transmission line, alignment and preliminary location of access roads needed for construction. The amount of road construction and number of stringing sites for each alternative transmission line route are shown in Table 4-34.

Reclamation and Weed Control

Existing vegetation would be removed for construction of access roads, for leveling working areas near sites, for pole installation or line stringing, and possibly for trenching to install grounding wire for individual structures. Vegetation removal and grading may not be required on level or gently sloping ground or where an existing road can be used. The areas disturbed by construction would be susceptible to the growth and spread of weeds.

Prevention of weeds on land disturbed by construction is best accomplished by prompt re-establishment of perennial grass or other cover, followed by inspection and spot control of any new stands of weeds. Specific measures to achieve this

Figure 4-6.
Land Uses and Ownership Along the Transmission Line Alternatives.

mitigation are contained in Section 4.4 of DNRC's Environmental Specifications.

Noxious weeds may spread by construction vehicles and equipment. This is a potential problem on all routes since all routes would affect areas where weeds are now present, such as the Sedlak Park substation area. Spread of weeds could be mitigated by either using different construction machinery on infested areas and non-infested areas or washing vehicles to remove weed parts and seeds before leaving an infested area (see Section 2.8, DNRC's Environmental Specifications).

The Montana Weed Law makes it unlawful to permit any noxious weed to go to seed. The responsibility for weed control under this law rests with the landowner. If the owner of the land refuses to control the weeds, the county can assume responsibility and receive reimbursement through a tax lien on the property. At present, the responsibility for control of the existing weed problems along the proposed alternative centerlines rests with the present owner. Noranda's responsibility to assume control of this weed problem would depend entirely upon the terms of easement agreements. If the Board were to approve the transmission line, Noranda would have responsibility under the Major Facility Siting Act certificate to prevent the spread of weeds to new areas from the right-of-way disturbed by construction activities.

To control the spread of weeds, Noranda has proposed using DNRC's Environmental Specifications, including measures for revegetation. The DNRC, Noranda, local weed control boards, and the KNF would cooperate to modify these measures to require a pre-construction survey along the approved centerline and access roads. This survey would determine the location of existing weed-infested areas; post-construction monitoring efforts would be focussed in these areas. Long-term weed control would require Noranda to prepare and implement a weed control plan approved by the Lincoln County Weed District and the KNF.

ALTERNATIVE 4

Noranda would use a helicopter rather than a crawler tractor during initial stringing operations. Conventional transmission line construction equipment would be used to complete stringing operations (see Figure 2-17). Up to seven miles of graded access for line stringing would be eliminated, reducing possible erosion and revegetation problems. All other impacts would be similar to those described for Alternative 1, except Alternative 4 would require less new road construction (Table 4-34). Alignment changes in the vicinity of the Libby Creek Recreation Gold Panning Area would require an additional 0.5 mile of access roads for equipment, but this would result in the reduction of impacts to recreation at this site.

ALTERNATIVE 5

Portions of the Alternative 5 route coincide with and would cause the same impacts as Alternative 4. Alternative 5 diverges from Alternatives 1 and 4 to follow about 1.5 miles along an unnamed intermittent stream to the divide between Miller and Midas creeks. Existing access to most structures sites on this segment is poor, and would require new access roads. About half of these roads would be on steep slopes. The southernmost half mile of this segment crosses highly erodible soil. This material also is prone to mass movement. Access roads would have to be located carefully to avoid causing long-term erosion and sedimentation.

Slopes in the southernmost half of this segment are about 10 to 15 percent, while slopes nearer the divide exceed 40 percent. Soils on the south-facing slopes near the Miller Creek-Midas Creek divide are shallow and may prove difficult to revegetate. Access roads would be required to access four structures located in an area mapped by the KNF as having poor reclamation potential.

Near the divide between Miller and Midas creeks, Alternative 5 and Alternative 6 converge and then coincide as they cross a ridge line and proceed downhill to join the proposed alignment of other alternatives near the crossing of Libby Creek. Slopes along this segment are generally in the 20 to 40 percent range. The first 0.7 mile of the segment closely parallels an existing road which could be re-opened and used for construction access. On the portion of the segment in the Howard Creek drainage, existing roads could provide access to about three of seven structures. Short-term increases in erosion could occur until revegetation is successful on new access roads.

Alternative 5 would require fewer new access roads than Alternatives 1 and 4 but more than required for Alternative 6. Alternative 5 also would require more roads on highly erodible soils than Alternatives 1, 4 or 6, and is the only alternative that would disturb areas identified by the KNF as difficult to reclaim.

ALTERNATIVE 6

Alternative 6 coincides with all alternative routes for the first four miles of line north of the Sedlak Park substation. Alternative 6 continues north about one mile over gently sloping hills composed of silt before turning northwest and crossing the Fisher River. New roads would be needed to two structures in this segment, while an existing road would serve four structures and cross country access would be used for one additional structure. Short-term increases in erosion would likely result until disturbances are revegetated.

After crossing the Fisher River, the route first crosses a short, steep slope and then proceeds about 1.5 miles across a relatively flat bench. Existing roads would provide access to about four of ten structures, and two to three structures located on flat ground could be reached by traveling overland. After traversing the bench, the proposed segment is located in a swale as it proceeds north and drops in elevation before reaching U.S. 2.

After crossing U.S. 2, the route turns west across moderately steep to steep slopes before reaching the Swamp Creek-Midas Creek divide. This area has been extensively logged and existing roads would provide access to about 11 of 20 structure sites. Short spur roads would be needed to reach the remaining structures, and these would result in some short-term erosion.

After crossing the Swamp Creek-Midas Creek divide, Alternative 6 crosses 600 feet of very steep slopes. One structure probably would be located in this steep area, and a 400-foot spur road from an old logging road would be required. Fairly extensive roads would be required on steep slopes in the last 0.5 mile of this segment; short-term erosion would occur until revegetation is successful.

The impacts on segments from Howard Creek to the mine substation would be the same as for the other alignment alternatives.

CUMULATIVE IMPACTS

The cumulative impacts of all action alternatives are similar. The ASARCO Rock Creek Project, the project, and projected timber sales in the project area would result in increased disturbance. Clearing of vegetation and increased soil erosion would result from this disturbance. The Rock Creek Project, however, would affect a different watershed. Implementation of Best Management Practices for Forestry would reduce the amount of soil lost as a result of logging.

U.S. 2 road reconstruction would also result in additional soil disturbance and vegetation clearing.

RESOURCE COMMITMENTS

Under Alternatives 1, 2 or 3, the Northern Beechfern population and about five woolgrass plants in the Little Cherry Creek impoundment area would be irreversibly lost. Some soil would be lost during construction and prior to reestablishment of vegetation. Minor deleterious effects on soils would

result from prolonged stockpiling, but following soil replacement, most soils should reach pre-mine productivity levels over time. Soil productivity in the impoundment area would be irreversibly reduced, and along the access roads would be irretrievably reduced.

ALTERNATIVE 7

Soil and vegetation resources would not be affected. Increased erosion would not occur and the areas of wetlands and old growth timber would not be disturbed.

LAND USE

SUMMARY

Land uses in the project area include wildlife habitat management, recreation, timber harvesting, mineral development and grazing. Direct land use impacts would be localized and occur as a result of construction of surface facilities, access roads and the transmission line. Permit areas around the facilities would be about 3,400 acres, of which about 1,270 acres would be disturbed. Land uses in Libby and surrounding areas would likely be affected by new residential and commercial development occurring as an indirect effect of mine development.

About 37 percent of lands crossed by the proposed transmission line are classified as transmission line corridor avoidance areas. The transmission line under Alternative 1 would pass within one-quarter mile of six residences and two developed recreation areas.

Reclamation would result in the revegetation of all disturbed lands. The portions of the 994-acre tailings impoundment area and the 22 acres associated with the Bear Creek access road improvement would not be capable of supporting pre-mining uses. Some areas may not be successfully revegetated, resulting in reduced productivity. Noranda would work with the KNF to develop appropriate management for the tailings impoundment following operations.

Under Alternative 2 and 3, Noranda would restore the Bear Creek Road to its pre-mining width, depending on the future needs of the Forest. The KNF would amend the Forest Plan for the mine site and tailings impoundment area to MA 31—Mineral Development. MA 31 would not be suitable for timber production. Less surface disturbance may occur under Alternative 3. Disturbance of 80 acres for the land application disposal areas, proposed for an area currently managed for grizzly habitat, may not occur under Alternative 3A. Additional land application disposal areas would be required under Alternative 3C. The KNF also would amend the Forest Plan to change about 130 acres surrounding the Libby Creek Recreation Gold Panning Area from MA 14 to MA 6.

Transmission line impacts associated with Alternative 4 would be similar to Alternative 1. Less land classified as corridor avoidance areas would be crossed by Alternatives 5 and 6. The KNF would amend the Forest Plan for areas classified as corridor avoidance areas under Alternatives 4, 5, and 6 to MA 23—Electric Transmission Corridor. Alternative 5 would pass within one-quarter mile of six residences and Alternative 6 would pass within one-quarter mile of eight residences; both alternatives would pass near a developed recreation area. No changes in land use would occur under Alternative 7

ALTERNATIVE 1

During the life of the operation, use of the lands disturbed by the project would be devoted to mining and associated activities. The permitted area would total 3,400 acres; about 1,270 acres would be actually disturbed. Adjacent land use during the operation would be affected to some extent—these impacts are described in other sections on recreation, noise, visual resources and wildlife. Access to some areas outside actual disturbed areas would be restricted during the years of operation. Timber sales and harvests would continue in the area if grizzly bear habitat would not be adversely affected.

The Ramsey Creek plant site and the land application disposal areas would be located entirely on national forest lands administered by the KNF. These lands are currently used primarily for wildlife habitat, recreation, commercial timber production, mineral development and grazing. They are managed under multiple use guidelines in accordance with the KNF Forest Plan (Kootenai National Forest, 1987). The plant site would be located in a current Management Area (MA) 2–Semi-primitive non-motorized recreation. The goal of this MA is to provide for the protection and enhancement of areas for roadless recreation use and to provide for wildlife management where specific wildlife values are high. The semi-primitive recreational opportunities in upper Ramsey Creek would be significantly affected by the plant and associated traffic (see Recreation section). The area has a high value as grizzly bear habitat (see *Wildlife* section).

The proposed land application disposal area would be in a current MA 14, managed specifically for grizzly bear habitat. The land application disposal areas and associated facilities would disturb nearly 80 acres of this habitat. Facilities which require frequent maintenance or occupancy normally are not allowed in MA 2 and 14. Activities associated with mineral development, however, are allowed in MAs 2 and 14 under the Forest Plan.

The Libby Creek adit area is a patented mining claim. The adit would not affect surrounding land uses.

A portion of the impoundment would be on private land (about 356 acres). The remaining portion of the tailings impoundment would be located in a current MA 14, with a small portion (~25 acres) affecting MA 13, Designated Old Growth Timber.

A small livestock grazing allotment occurs within the project area. Although this allotment would not be directly affected, increased traffic and increased population might lead to increased poaching of livestock. Given the small size of the allotment (30 head of cattle), any livestock loss as a result of the project could significantly affect the livestock operation.

Most lands disturbed by mining would be revegetated. The Bear Creek Road from U.S. 2 to the Bear Creek bridge would not be restored to its narrower pre-mining width. Successful reclamation would result in reforestation of disturbed lands. The goal of reclamation would be to restore lands to productive use (see *Soils, Vegetation and Reclamation* section). The 994-acre tailings impoundment area and the 22-acre disturbance associated with the upgrade of the Bear Creek Road would not be capable of supporting pre-mining uses. Timber harvest would be restricted on the impoundment. Noranda proposes to return the access road from the Bear Creek bridge to the plant site to its pre-mining width unless the KNF desires a wider road. The access road from the Bear Creek bridge to U.S. 2 would be left as a 20 to 29-foot road. Responsibility for road maintenance would return to the KNF following project completion.

Other areas, over time, would return to pre-mine uses and productivity. At the end of active mining, the transmission line would be removed. The BPA would remove the substation and microwave repeater unless other feasible uses occur at or near project completion. Areas associated with the transmission line corridor would be revegetated.

Noranda has identified about 18 miles of National Forest System road that could potentially be closed on a year-round basis and an additional 20.1 miles of National Forest System road that could be closed on a seasonal basis from April 1 through June 30 each year (Figure 2-22 in Chapter 2). Noranda believes, however, that it would be necessary to close only 11.1 miles of road. Road closures would reduce motorized access on the east side of the Cabinet Mountains (see *Recreation* section).

Special Management Area

The tailing impoundment area would be revegetated. Because the reclaimed impoundment site would incorporate permanent structures such as the tailings dam and diversion channel, special considerations would be needed to ensure permanent integrity of this site. Minimizing erosion on this site would be a critical consideration. Accordingly, Noranda has recognized in the permit application that such an area should be considered for designation by the KNF as a "special management area" having special provisions which would be incorporated in the KNF's Forest Plan.

Noranda would develop specific technical recommendations at the end of the project for KNF with regard to "special management" considerations of the reclaimed tailings impoundment area. These recommendations would provide measures to preserve the long-term integrity of the tailings dam and impoundment and would include appropriate erosion control monitoring and maintenance plans, and constraints for recreational uses, and timber production. If timber production is not feasible on the disturbed areas associated with the impoundment, 994 acres of suitable timber land would be permanently lost.

Transmission Line

Affected land uses. All alternative routes would cross Champion International forest land along the Fisher River. Champion land is managed primarily for timber production; some dispersed recreation also occurs on Champion land. Transmission line construction would require logging the powerline corridor, which is compatible with Champion's land management. Following construction, the transmission line could restrict cable logging in areas adjacent to the line. Champion's land management objectives probably would accommodate longer term management as a transmission line corridor. This alternative would cross the northeast corner of patented private land south of Howard Lake for a distance of 0.1 mile, requiring up to 3 acres of transmission line right-of-way.

The remaining 9.3 miles of Alternative 1 are on KNF land. The line would cross 6.2 miles (376 acres) of land that the KNF has identified as corridor avoidance areas because transmission line-related impacts would be difficult or impossible to mitigate (Table 4-35). Although not proposed by Noranda, a Forest Plan Management Area change is recommended to make this alternative consistent with the Forest Plan. The new Management Area would be MA-23 (electric transmission corridor) which would be compatible with the proposed transmission line (MA-23 is presented in Appendix G). About 84 percent of land (14.0 miles) on this route is in management areas suitable for timber production, of which about 17 percent (2.9 miles) is already logged (Figure 4-6).

The route would pass within 1/4 mile of six residences and two recreation areas–Howard Lake Campground and the Libby Creek Recreation Gold Panning Area. There is no mechanically irrigated land within 1,000 feet of the proposed line.

To provide for monitoring of the Sedlak Park transmission line substation, a passive microwave repeater site would be constructed on a ridge east of Barren Peak about 3 miles west of Sedlak Park (see Figure 4-6). This passive repeater station, which would resemble a billboard, would require about a quarter acre of cleared land. Because the repeater

would be installed using helicopters, no additional clearing for access roads would be necessary.

The repeater would consist of a reflective panel approximately 30 feet tall by 40 feet wide. It would be located on KNF land that has forest Regeneration Problems (MA 18). Facilities which require frequent maintenance or occupancy normally are not allowed in this area. The microwave repeater would need to be inspected approximately once a year. The Barren Peak area is not identified in the Forest Plan as a communications site and would require KNF action to designate this area as an electronic site. The impacts of the Barren Peak communication site are common to all alternatives.

Roads have been built in connection with logging and mineral exploration along Fisher River, Miller Creek, Howard Creek, and Ramsey Creek. U.S. 2 along Fisher River is a major all-weather paved highway. The Miller Creek, Howard Creek, and Ramsey Creek areas are accessible on Forest Service roads which are only plowed for wintertime logging or mineral development. Under Alternative 1, the Bear Creek road would have improved wintertime access, but approximately 5.6 miles of the transmission line would be beyond the plowed wintertime access areas. All transmission line alignment alternatives would require crossing about 1,000 feet of area prone to avalanches at the mouth of the Ramsey Creek drainage.

Table 4-35. Management emphasis of land affected by the transmission line routes.

Land manager/ management area (MA) emphasis	Alternative 1	Alternative 4 Miller Creek	Alternative 5 North Miller Creek	Alternative 6 Swamp Creek
	miles crossed by each alternative			
KNF Land–Transmission line corridor avoidance areas				
MA 2–Semi-primitive non-motorized recreation	2.1	2.1	2.1	2.1
MA 12–Big game summer range§	2.0	2.0	0.0	0.0
MA 13–Designated old growth	0.5	0.5	0.1	0.4
MA 14–Grizzly habitat	1.6	1.5	1.5	1.5
MA 19–Steep land	0.0	0.0	0.0	0.2
Subtotal	6.2	6.1	3.7	4.2
KNF Land–Transmission line corridors permitted				
MA 11–Big game winter range	2.0	2.0	1.6	2.1
MA 12–Big game summer range§	0.0	0.0	0.0	1.7
MA 15–Timber production	0.2	0.3	1.4	1.6
MA 16–Timber with viewing	0.9	1.0	0.0	.3
MA 17–Viewing with timber	0.0	0.0	0.0	.3
MA 18–Regeneration problem areas	0.0	0.0	2.4	1.1
Subtotal	3.1	3.3	5.4	7.1
Private land				
Champion International	7.2	7.2	7.2	5.6
Other private†	0.1†	0.1†	0.0†	0.4†
Subtotal	7.3	7.3	7.2	6.0
Total	16.6	16.7	16.3	17.3

Source: Department of Natural Resources and Conservation. 1992.
§This MA is a corridor avoidance MA only in designated grizzly bear habitat.
†Depending on final centerline location, up to 100 yards of additional private land along Fisher River might be crossed.
Totals may not add due to rounding.

Future timber harvests are expected on Champion International land along Fisher River and lower Miller Creek. The KNF has two timber sales scheduled in the 1990s (total of 14 million board-feet on 700 acres) that would be affected by the transmission line (D. Crawford, Libby District Timber Resource Staff, written comm. with R. Trenholme, November 30, 1989). These sales would require an estimated 5.5 miles of new road construction and 3 miles of improvements on existing roads. The proposed transmission line would preclude future logging within the 100-foot cleared right-of-way and would restrict the use of some special logging equipment (cables, jammer poles) near the line where use of such equipment would pose a safety hazard. The line may restrict some placer mining activities and equipment beneath or adjacent to the line.

Alternative 1 would require clearing of about 172 acres in areas managed for timber and 43 acres in areas managed for natural values. This clearing would produce an estimated 4.3 million board-feet of timber. About 37 acres would be dedicated to road access used for line maintenance over the life of the project. Some of these roads might be useful for other activities and could remain in place after the line is removed.

Access road construction. Alternative 1 would require construction of about 12.6 miles of new access roads or trails in areas identified in the Forest Plan as being suitable for timber harvest (Table 4-36). About 25 percent of new transmission line roads also would provide access to timber sale areas reducing the amount of road construction needed during logging. Approximately 2.5 miles of new road would be constructed in areas managed for semi-primitive recreation, old growth, and forest habitats and soil protection. New roads in these areas are not allowed by the Forest Plan. Alternative 1 would require road access into currently roadless portions of the upper Miller Creek drainage.

Indirect Impacts

Some land use changes may occur as a result of the Montanore Project. As discussed under *Socioeconomics*, some in-migrating employees and their families would require additional housing. Limited new commercial activity would also result from the project. The vast majority of this housing and commercial business development would occur in areas already dedicated to that type of use. Development patterns are constrained by availability of infrastructure, floodplain, land ownership, and steep topography. Existing patterns of growth and development in the Libby area include—

- major residential development in the town of Libby, south along U.S. 2, and north across the river in scattered subdivisions;
- a commercial city-center in Libby;

Table 4-36. Estimated miles of road construction needed by the transmission line routes.

Land type	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	miles of new road constructed			
Suitable logging areas	12.6	4.8	2.1	2.7
Unsuitable logging areas (no logging)	2.5	2.5	3.7	2.9
Total	15.1	7.3	5.8	5.6

Source: Department of Natural Resources and Conservation. 1990.

- major commercial strip development along U.S. 2; and
- limited off-highway commercial center development in the western portion of the town of Libby.

These general patterns would readily incorporate any additional residential and commercial development resulting from the Montanore Project.

As discussed in the Socioeconomics section, most of the long-term operations workforce is expected to locate outside the city of Libby. With an overall long-term influx of an estimated 58 families into rural Lincoln County, it is possible that new subdivision development may occur at some point in the future to meet a specific market demand. In the short-term, however, it is more likely that these families would locate into existing residential land use areas. It is impossible to precisely forecast where any specific new development might occur. It is reasonable to assume that a new subdivision of 20 to 30 homes (or 20 or 30 new homes in scattered areas) would convert 10 to 15 acres of land near Libby to residential use.

With the current state of the local economy and patterns of commercial development, it is unlikely that Montanore Project development would cause any major conversion of land to commercial uses because of the existence of vacant commercial space. While it is likely that business would expand in the Libby area due to Montanore Project development, there is sufficient capacity in existing commercial areas to accommodate any new commercial development.

ALTERNATIVE 2

The KNF would amend the Forest Plan (Kootenai National Forest, 1987) for the proposed mine site and tailings impoundment area. The new management area for these areas (about 1,039 acres), would be MA 31–Mineral Development. Management Areas are discussed in more detail in Chapter 3, Kootenai National Forest Management. The goals and objectives of MA 31 are described in Appendix E.

Noranda would return the Bear Creek Road from the Bear Creek bridge to U.S. 2 to its pre-mine width, unless the KNF should want a wider road. Successful revegetation of the 22 acres associated with this disturbance would restore pre-mine productivity and use.

The KNF would amend the Forest Plan for about 130 acres surrounding the Libby Creek Recreation Gold Panning Area. The area would be changed from MA 14 to MA 6. This change would accommodate construction of developed recreational facilities. It would not affect the space available for the grizzly bear; most of the 130 acres is currently considered unavailable since the area is in a road influence zone.

Other impacts for Alternative 2 would be similar to those for Alternative 1.

ALTERNATIVE 3

If mechanical water treatment is used for all excess water and land application is not necessary, the disturbance associated with the land application disposal area may not occur. Alternative 3C would use of additional LAD areas in the tailings impoundment area. Increased disturbance would result if these areas are used. Other impacts for Alternative 3 would be similar to those for Alternatives 1 and 2.

IMPACTS COMMON TO ALTERNATIVES 4, 5, AND 6

The common segment of all transmission line alternatives would cross areas of Champion International forest land from the substation north along the Fisher River. Champion's land management objectives probably would accommodate a transmission line. About 1 mile northwest of the proposed Sedlak Park substation, the line may cross or span up to 100 yards of privately owned land managed for forest uses. Most of each route would cross KNF land managed under the KNF Forest Plan (1987) (Table 4-35).

Typically, a transmission line requires a dedicated right-of-way cleared of trees to provide for line operation and safety. Long-term roads are constructed to install poles and to provide for future maintenance. Land uses within the right-of-way may be restricted to provide for line operation and safety. This can limit adjacent logging and mining activities. Potentially affected unpatented mining claim owners have indicated they are not particularly concerned about the possibility of a transmission line along Alternatives 4, 5, or 6 (Stearns, 1991). Alternatives 4, 5, and 6 avoid placer claims along Libby Creek where a transmission line could impede claim development. All alternatives would avoid private land along Howard and Libby creeks just to the north of the Recreation Gold Panning Area.

Under Alternatives 4, 5, or 6, portions of KNF management areas that are "corridor avoidance" areas (see Table 4-35) would be changed to Management Area 23–Electric Transmission Corridor, if the transmission line is approved. Under Management Area 23, land management along the line would change from the present direction for uses listed in Table 4-37 to long-term management as a transmission line corridor.

Table 4-37 lists the miles of management areas crossed by each alternative where timber cutting is not allowed. Under current management, these areas are designated as unsuitable for timber production. Redesignating Management Areas shown in Table 4-37 to Management Area 23 under Alternatives 4, 5, or 6 would authorize clearing for a right-of-way within the newly designated management area. This new designation would preclude any future logging within the management area except clearing necessary for right-of-way maintenance over the life of the transmission line.

ALTERNATIVE 4

This alternative would cross the northeast corner of

Table 4-37. Acres of KNF land to be reallocated to Management Area 23 (electric transmission corridor) for each transmission line alternative.

Present Management Area	Alternative 1 and 4	Alternative 5	Alternative 6
	acres redesignated to MA-23		
Management Areas Not Suitable for Timber Harvest			
MA 2–Semi-primitive non-motorized recreation	127	127	127
MA 13–Designated old growth	30	6	24
MA 19–Steep land	0	0	12
Subtotal Not Suitable for Timber Harvest	157	133	163
Management Areas Suitable for Timber Harvest			
MA 12–Big game summer range†	121	0	0
MA 14–Grizzly habitat	91	91	91
Subtotal Suitable for Timber Harvest	212	91	91
Total Reallocated to MA 23	369	224	254

Source: Department of Natural Resources and Conservation. 1992.
†This MA is a corridor avoidance MA only in designated grizzly bear habitat.
Based on a 500-foot right-of-way or 60.61 acres per mile of transmission line; totals may not add due to rounding.

patented private land south of Howard Lake for about 0.1 mile, requiring up to 3 acres of transmission line right-of-way across this land. One transmission line pole might be located on this property. Selection of Alternative 4 would require changing 369 acres of KNF land from the designated use listed in Table 4-37 to Management Area 23.

The estimated 233 acres of clearing would produce approximately 4.3 million board feet of timber. The logged area would include 40 acres of KNF land where timber management is not allowed.

ALTERNATIVE 5

Under Alternative 5, about 224 acres of KNF land would be changed from present use designations to Management Area 23–Electric Transmission Corridor, to permit line construction (Table 4-37). Approximately 221 acres, including about 57 acres of land where timber management is not allowed, would be cleared of trees, providing approximately 3.4 million board feet.

ALTERNATIVE 6

Alternative 6 would require 254 acres of KNF land be changed from the use designation shown in Table 4-37 to Management Area 23–Electric Transmission Corridor, to permit line construction. This alternative would cross 0.4 mile of private land just west of the Fisher River, requiring up to 10 acres of transmission line right-of-way across two private parcels. Based on preliminary information, it appears that three structures would be located on this land. About 246 acres would be logged for the transmission line and access roads, including 51 acres of land where timber management is not currently practiced, and clearing would provide approximately 3.9 million board feet of timber.

CUMULATIVE IMPACTS

The cumulative impacts of all alternatives are similar. The ASARCO Rock Creek Project, the Montanore Project, and proposed timber sales in the Montanore Project area would result in disturbance of about 3,400 acres, 2,900 acres of which would occur on the east side of the Cabinet Mountains. Motorized access would be restricted around project facilities.

RESOURCE COMMITMENTS

Over half the land proposed for disturbance would not return to pre-mine uses. The tailings impoundment area, which would be managed for mineral development following operations, would no longer be managed as suitable for timber production. Under Noranda's proposal, an additional 22 acres associated with the Bear Creek access road would not be reclaimed. The road would be returned to its pre-mine width under the other action alternatives, unless the KNF should want a wider road. Timber harvesting would be sooner in areas cleared for project facilities. These resources would be irreversibly affected. Any indirect development associated with the project, such as new residential or commercial development in or around Libby, would likely be permanent.

ALTERNATIVE 7

The land use impacts of the proposed project would not occur under this alternative except for those associated with the exploration adit on private lands in Libby Creek. Existing land use patterns on Champion International and Forest Service lands would continue, including recreation and timber harvesting.

RECREATION

SUMMARY

With development of the Montanore Project, recreational opportunities would generally remain abundant in the area and region. Increasing recreation demand in the Libby Creek drainage would significantly affect Howard Lake Campground and the Libby Creek Recreation Gold Panning Area. The wilderness experience of some individuals would likely be adversely affected by views of project facilities from several locations within the Cabinet Mountains Wilderness. Road closures for grizzly bear mitigation would reduce motorized recreational opportunity and increase semi-primitive, non-motorized opportunity. Alternatives 1, 2, and 3 would directly impact approximately 25 acres, or 0.05 percent, of the Cabinet East Face Roadless Area. Traffic would be reduced under Alternatives 2 and 3 through implementation of an agency-approved traffic management plan.

Under the remaining action alternatives, proposed mitigation, primarily limited recreation facilities development at the Libby Creek Recreation Gold Panning Area, would reduce the impacts to the developed recreational areas from mine-related developments. The transmission line would be rerouted to avoid the Libby Creek Recreation Gold Panning Area. No recreation impacts would occur under Alternative 7.

ALTERNATIVE 1

Recreational Opportunity

General access to recreational areas would be minimally affected by project development for those areas contiguous to project operations. Access would be affected temporarily by delays and increased traffic during the construction phase of the project. Both foot and vehicle access would be restricted in the immediate vicinity of project facilities. The public would be restricted from the permitted mine area for safety and security reasons once construction has begun. Undisturbed areas that are not fenced would continue to be open to the public. Access to the Poorman Creek and Cable Creek drainages would be coordinated with the KNF, and project activities would not restrict access to these drainages. Access to the Ramsey Creek drainage would be restricted by a gate at the plant site boundary. Access to public land on Libby Creek would be largely unaffected by the project. The existing Libby Creek Road would remain in place, and access to the portal and disturbed areas would be restricted by gates and fences. Noranda would instruct employees that areas restricted to public access for hunting and other recreational activities would also be restricted from off-duty employee use. Overall, project development would alter the travel patterns and access routes to adjacent areas for some individuals.

Population growth associated with the project would slightly increase the demand for recreation. While there is an abundance of regional recreational opportunities, environmental effects of project development and increased demand would reduce the quality of current recreational opportunities in some areas. The view of project facilities and increased traffic associated with project development would diminish the traveling and viewing experience for some individuals.

In its grizzly bear mitigation plan, Noranda has identified about 18 miles of National Forest System

road that could potentially be closed on a year-round basis and an additional 20.1 miles of National Forest System road that could be closed on a seasonal basis from April 1 through June 30 each year (Figure 2-22 in Chapter 2). Noranda believes, however, closure of only 11.1 miles of road would be necessary. Of the 11.1 miles, 7.1 miles would be year-round closures and 4.0 miles would be closed in spring and early summer. The four roads that Noranda has identified as priorities for closure are the Libby Creek Road (#2316), the Cable-Poorman Road (#6214) the Lower Fisher Creek Road (#6744), and the Midas Creek Road (#4778). If these roads would not provide adequate habitat mitigation, other roads that could be closed based on their priority for providing grizzly bear mitigation are—the Upper Bear Creek Road (#4784), the Upper West Fisher Road (#6746 and #6746C), the Bramlett Creek Road (#2332), the Lake Creek Road (#6748), the Upper Miller Creek Road (#4724), and the Lower Granite Road (#4791). These closures would reduce the recreational opportunity for travel and viewing, the predominant recreational use on the KNF. Similar motorized recreation opportunities in other drainages on the east side of the Cabinet Mountains that would offer similar scenic attributes do not exist.

Recreational Use

The project would displace some current recreational users of the project area. People seeking solitude on trails along Libby Creek, lower Ramsey Creek and Poorman Creek probably would substantially reduce their use. An estimated 75 people use these trails in the summer; the trails are used in the winter for skiing and snowmobiling. Although similar recreational opportunity offered in these drainages would be available in other drainages on the east side of the Cabinet Mountains, each affected drainage may have attributes which are not duplicated elsewhere in the area.

Because of their proximity to the project area, recreation facilities at Howard Lake and the Libby Creek Recreation Gold Panning Area would likely experience substantially increased use. The increased population and awareness by Noranda employees of the campground would increase the number of days that the campground is full. Since the campground is frequently full during the summer, the impact is likely to be significant.

Howard Lake Campground and the Libby Creek Recreation Gold Planning Area would be affected by the increased direct and indirect population. The setting for Howard Lake Campground would be affected where the proposed transmission line passes the lake approximately one quarter of a mile away. Impacts would be long term and moderate (see *Visual Resources* section). The Recreation Gold Panning Area would be directly crossed by the proposed line, creating a visual intrusion for recreational users at this site. This impact would be long term.

Construction of the tailings impoundment and related facilities would eliminate the recreational fishing opportunity currently provided by Little Cherry Creek. While this use is small, current users would be displaced to other adjacent streams or lakes.

Some dispersed recreation use might occur at the proposed substation site at Sedlak Park, though activities and use levels are unknown. Recreational users of this site would probably be displaced to nearby KNF land during and following substation construction.

Travel and viewing is the primary recreational use in the Libby District. Noranda would widen the proposed access road to accommodate increased traffic. Although the road would be capable of handling safely a larger amount of traffic, some current users may find the increased traffic decreases their traveling and viewing pleasure. Other users may find that the safety of a double lane road enhances their viewing experience.

The structures, access roads, and right-of-way associated with the transmission line would visually intrude on recreation settings, whether they are developed or dispersed. This decline in the scenic

quality can adversely affect recreation visitors, especially in settings where concern for natural beauty is high. The transmission line and access roads would conflict with visitor expectations for undeveloped landscapes, even if the actual visual impact is small. Access roads associated with transmission line construction can open new areas for recreation, benefitting recreational users who desire to use them and adversely affecting recreational users who desire non-roaded settings.

Increased traffic levels, dust, and noise would occur on area roads during transmission line construction. The sights and sounds of road and line construction, and right-of-way clearing would detract from the natural setting. Those recreational users seeking solitude would be displaced from areas undergoing construction. This would be a short-term and localized impact.

The main impact to recreation settings would be the visual intrusion of the project facilities. These impacts are discussed in the *Visual Resources* section.

Cabinet Mountains Wilderness

The Wilderness Act directs the Forest Service to protect the natural character of wilderness and to provide for recreational, scenic, scientific, educational, cultural, and historical uses of wilderness areas. Based on the Wilderness Act's definition of wilderness, the Forest Service describes four requisite attributes of wilderness as—

- natural integrity;
- apparent naturalness;
- outstanding opportunities for solitude; and
- opportunities for primitive recreation.

These attributes are applied to the conditions inside the boundaries of the wilderness. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not require that adverse affects associated with those activities be mitigated. Buffer zones for adverse effects are considered to be inside and not outside the wilderness boundary.

All proposed surface disturbances would occur outside the wilderness boundary. As discussed more fully in the *Visual Resources* section, the Montanore Project would affect the existing wilderness environment from three key viewpoints within the Cabinet Mountains Wilderness—Elephant Peak, Bald Eagle Peak, and Snowshoe Peak. Visitors to Elephant Peak would have a direct view of the plant facilities. The visitors to Bald Eagle Peak would have a distant view of the land application disposal areas. Visitors to Snowshoe Peak would have a distant view of the tailings disposal impoundment. Existing roads and timber harvesting areas would also be visible from these areas.

Each of these wilderness peak destinations is currently used by an estimated one to four hiking parties per month over the June to September period (C. Howard, Resource Assistant, pers. comm., w/ M. Stanwood, January 24, 1990). At four persons per party and three parties per month per viewpoint, the wilderness experience of approximately 144 persons could be adversely affected by project development.

Noise from project facilities would be audible at certain wilderness locations near the facilities. The zone of audibility within the wilderness would not be extensive, and actual recreational use within this zone (relative to total recreational use within the wilderness) would be of little significance. Noise impacts would be greater during construction, but would be temporary, and would cease at project's completion.

The wilderness experience is highly personal and individual, so the effects would differ among individuals. It is likely that project development would have significant adverse impacts on the wilderness experience of some individuals at selected locations within the wilderness. Although some evidence of human activity already exists within the wilderness (e.g., trails, litter), all four requisite

attributes of wilderness experience would be diminished during the life of the project at some specific locations within the wilderness. The effects would occur during the project operations and diminish as activity decreases and revegetation increases.

Roadless Areas

The area surrounding the proposed plant site and portions of the access road to the plant and transmission line corridor are within the boundaries of the Cabinet Face East Roadless Area described in the KNF Forest Plan FEIS (Kootenai National Forest, 1987, Appendix C). The roadless area is located along the eastern edge of the Cabinet Mountain Wilderness, extending about 36 miles south from Libby (see Figure 3-13 in Chapter 3). The area includes 54,800 acres of mostly NFS lands and some private lands. The average width is approximately 2 miles. The proposed activities would directly affect about 25 acres, or 0.05 percent, of the roadless area in the Ramsey Creek drainage.

Natural integrity and apparent naturalness. The roadless area boundary excludes most improvements and all roads, leaving the inventoried area very natural appearing. Alternative 1 would not change the overall appearance of the roadless area. On-site changes in apparent naturalness would occur, but the impacts would not extend beyond the access road right-of-way or beyond the physical bounds of the plant site.

Opportunities for solitude. The northern half of the roadless area offers good opportunities for solitude because of forested slopes and lack of roads. The southern half offers moderate opportunities for solitude because of the existing low standard roads that penetrate within the steep canyons. The proposed facilities in Ramsey Creek would further reduce a person's opportunity for solitude in the immediate watershed area because of the sights and sounds that would be generated by the mine development. Some of the proposed road closures included in the grizzly bear mitigation plan, would improve opportunities for solitude within the roadless area. Opportunities for solitude in the Cabinet Face East Roadless Area, as a whole, would not be significantly affected.

Primitive recreation opportunities and other features. Primitive recreation opportunities available in the Cabinet Face Roadless Area include hiking, hunting, stream fishing, and horseback riding. Snowmobiling is allowed on the existing roads that penetrate deep into the drainages. These roads are outside the inventoried roadless area. Challenging experiences are available such as rock climbing on the steep rock faces and cross-country ski touring, primarily in the south half of the roadless area.

Alternative 1 would make access to portions of upper Ramsey Creek drainage beyond the plant site very difficult, essentially eliminating recreational opportunity in those portions. The access restriction would continue for the life of the project. Primitive recreation opportunities would not be affected in the balance of the roadless area.

Roadless Area manageability and boundaries. This long, linear roadless area has a boundary which is easily defined in some places and less so in others. Throughout its entire length, the roadless area produces a net gain in the manageability of the adjacent wilderness area through an increased size relative to its border.

The least desirable parts of the inventoried roadless boundary are the narrow corridors drawn to exclude the roads in certain drainages including Ramsey Creek. In its present configuration, this boundary would allow nonconforming uses well within the topographic confines of a potential wilderness. Under Alternative 1, portions of the plant site and portal, access road and transmission line would encroach on the roadless area boundary and would further complicate the establishment of any future wilderness boundary in Ramsey Creek.

However, when comparing the estimated disturbed acreage of the plant site and associated facilities with

the total acreage of the Cabinet Face East roadless area, the impacts on the roadless area characteristics would be negligible.

Special Features. There are no known unique geological, cultural or scenic features within the roadless area, within or adjacent to the proposed project area. There is known biological habitat for grizzly bears within the project area, which is a special feature of the roadless area; but because of the large acreage of the roadless area (50,400 acres of N.F. land), there will be a negligible effect on the habitat.

Special Places—Special Values. There are numerous special places, with special values, in the Cabinet Face East Roadless Area. A special place in the Ramsey Creek drainage is Ramsey Lake, a small (2 acre), secluded lake along the south side of Ramsey Creek, at the base of a steep north-facing slope. It is surrounded by an old growth timber stand. Ramsey Lake gets very little recreational use, perhaps because the trail to it is obscure and difficult to find. The project would have no direct effect on Ramsey Lake, but would preclude access to the lake. The plant site is proposed to be located about 1,000 feet north east of the lake.

ALTERNATIVE 2

Noranda would implement several measures to mitigate recreational impacts and increase recreational opportunity. If the Bear Creek and Libby Creek roads are snowplowed in the winter, Noranda would also snowplow turnouts. This would provide increased safety, access and recreational opportunity.

If warranted by increased use, Noranda would install three additional fire pits; construct a total 1/2 mile of new walking access in several locations; and install a precast concrete vault toilet at the Libby Creek Recreation Gold Panning Area. These measures would reduce the impacts of the anticipated increased use of the area.

To mitigate impacts to grizzly bears, the KNF would close six road segments in addition to those required to meet Forest Plan standards, along with extending the closure on the upper Bear Creek Road #4784 from Sept. 1 to June 30 (current motorized closure on this road is from Oct. 15 to June 30). The upper 6.4 miles of the West Fisher Road system would be closed yearlong by closure of three road segments (No. 6746, No. 6744, and No. 6746C) (Figure 2-23 in Chapter 2). These road closures would be in effect prior to beginning construction activities, and continue through the operating period and into the reclamation period. The Management Committee would evaluate the effectiveness of these road closures and, if determined to be ineffective, replace them with a yearlong closure of the Bear Creek Road #4784.

Three road segments would be closed on a seasonal basis (April 1 to June 30). These include the South Fork Miller Road (No. 4724), the Midas Creek Road (No. 4778), and the Deep Creek Road (No. 4791). These road closures would remain in effect throughout the project life and into the reclamation period. Proposed closures would be—

- The South Fork Miller Creek Road No. 4724 (6.6 miles) would be closed at the junction of the main Miller Creek Road No. 385;
- A "tie-through" road connecting Road No. 4724 with Road 4780;
- The Midas Creek Road No. 4778 (6.6 miles) would be closed at the junction of the main Libby Creek Road No. 231;
- The Deep Creek Road No. 4791 (5.2 miles) would be closed at the junction with Road No. 4792.

These closures would reduce the recreational opportunity for travel and viewing, the predominant recreational use on the KNF. Similar motorized recreation opportunities in other drainages on the east side of the Cabinet Mountains that would offer similar scenic attributes do not exist.

Other effects, including adverse visual impacts from other viewpoints, and effects on roadless areas would be as described for Alternative 1.

ALTERNATIVE 3

Alternative 3A may reduce the visual impacts associated with the Ramsey Creek LAD areas if the LAD areas are not constructed. The LAD sites would not be visible from Bald Eagle Peak and Elephant Peak within the Cabinet Mountains Wilderness. Alternative 3C would increase the amount of LAD areas in the Little Cherry Creek area. More LAD areas would result in limited increased clearing in the tailings impoundment area. The impact to recreational users of these locations would be increased. Other effects, including adverse visual impacts from other viewpoints and effects on Roadless Areas, would be as described for Alternatives 1 and 2.

IMPACTS COMMON TO ALTERNATIVES 4, 5, AND 6

Transmission line alternatives would affect recreation resources as a result of visual intrusion of the line and access in recreational settings. Proposed mitigation for visual concerns would reduce the visual intrusion of the transmission line for recreational users, though the right-of-way clearing, structures, and access roads would still be visible. Proposed access roads would continue to make previous non-roaded areas in upper Miller Creek more accessible to hunters and other recreational users. All alternatives also would affect a small portion of the Cabinet Face East Roadless Area as described under Alternative 1. The visual effects of the transmission line alternatives are discussed in greater detail in the *Visual Resources* section.

Transmission line construction also would result in increased traffic levels, dust, and noise on area roads. This would be a short-term impact, diminishing the recreation experience for some users.

ALTERNATIVE 4

Line location near Howard Lake would stay the same as in Alternative 1, but would be adjusted at the Libby Creek Recreation Gold Panning Area to avoid crossing the developed area. Depending on final centerline location, this adjustment could result in lower impacts to recreational users who use this area (see *Visual Resources* section).

ALTERNATIVE 5

This alternative would affect the setting of the Miller Creek drainage, creating a visual intrusion for some recreational users (see *Visual Resources* section). It would avoid the Howard Lake area and avoid crossing the developed area at the Libby Creek Recreation Gold Panning Area. A 2-mile segment of this alternative straddling the Miller Creek-Midas Creek divide would open a currently non-roaded area to new access.

Impacts in the Ramsey Creek drainage are the same as those for Alternative 1.

ALTERNATIVE 6

This alternative would affect the setting of Swamp and Midas Creek drainages, creating a visual intrusion for some recreational users (see *Visual Resources* section). Both of these drainages are characterized by low levels of use.

This alternative would avoid the Howard Lake area and avoid crossing the developed area at the Libby Creek Recreation Gold Panning Area. Impacts in the Ramsey Creek drainage are the same as those for Alternative 1. Changes in the setting for recreation sites and dispersed recreation activities resulting from construction of the transmission line are discussed in the *Visual Resources* section.

CUMULATIVE IMPACTS

Development of the ASARCO Rock Creek mine would likely have similar effects on recreation and

wilderness as those described for development of the Montanore Project. Population increases due to both projects would slightly increase demand for recreational opportunities in the region. Even with this increased demand, there would remain an abundance of outdoor recreational opportunities for residents and visitors alike. The increased traffic and noise from both mining operations would slightly diminish the quality of certain recreational experiences at specific geographic locations.

The Rock Creek development would not be evident from viewpoints identified for the Montanore Project visual analysis. Other viewpoints within the Cabinet Mountains Wilderness, however, would be affected by the Rock Creek Project in ways similar to those described above for Montanore Project development. Wilderness visitors of some locations would also be affected by the projected timber harvesting. From some areas, wilderness visitors could be cumulatively affected by adverse visual effects from two or more developments rather than just the Montanore Project. The cumulative effects of the proposed ASARCO Rock Creek Project, the Montanore Project, and planned timber harvest, when coupled with the existing clearcut areas visible from the Cabinet Mountains Wilderness, might contribute to a loss of wilderness attributes desired by for some individuals. Because of the large size of the Cabinet Face East Roadless Area, there would be an insignificant cumulative impact on the roadless resource.

RESOURCE COMMITMENTS

The recreational experiences of some individuals might be affected considerably by the project. The project would be visible from a number of key viewpoints, both in the Cabinet Mountains Wilderness and within the KNF, and, as a result, the travel and viewing quality of the forest might be perceived by some as significantly affected. Approximately 25 acres of roadless resource would be lost under Alternatives 1, 2 and 3. Development of the project would be an irretrievable commitment of these recreational resources.

ALTERNATIVE 7

Recreational opportunities and the wilderness experience would remain essentially as they are now.

VISUAL RESOURCES

SUMMARY

The Montanore Project includes five components that would create recognizable visual impacts—the plant site, the land application disposal and waste rock storage areas, the tailings impoundment, the access roads and the transmission line. Another project component, the Libby Creek adit, is presently under construction in upper Libby Creek. The plant would significantly affect the views from Elephant Peak. Because of the contrast in colors, particularly during the summer, the tailings impoundment would affect the view from the Bear Creek Road viewpoint and from two viewpoints on Libby Creek Road. The tailings impoundment area also would be fully visible from Horse Mountain Saddle. Although the low view angle of these viewpoints reduces the actual disturbed area seen relative to the size of the impoundment area, the size and color of the impoundment dam would be in significant contrast to the surrounding landscape. Two other viewpoints, Snowshoe Peak and Great Northern Mountain, would be affected by the tailings impoundment, but effects are low due to view distance and landforms. The land application disposal area would be visible from two

viewpoints in the wilderness and fully visible from Horse Mountain Saddle. None of the identified viewpoints would be affected significantly by the Bear Creek Road improvements.

Under Alternatives 2 and 3, Noranda would undertake a roadside tree management program to reduce or mitigate visual impacts. Alternative 3 may reduce the visual impacts associated with the Ramsey Creek land application disposal area. Additional land application disposal areas would be constructed in the Little Cherry Creek area under Alternative 3C.

Short segments of all transmission line alternatives (1, 4, 5, and 6) would be visible from wilderness viewpoints where the cleared right-of-way passes through dense timber. For most wilderness viewpoints, impacts would be low due to the background distance of the transmission line and existing modifications compete for viewers' attention.

ALTERNATIVE 1

Noranda and the agencies identified viewpoints of the project facilities based on proximity to the project area (Figure 4-7). The sensitivity of each viewpoint was determined on the basis of definitions of viewing significance contained in the Forest Plan (Kootenai National Forest, 1987). Roadways and recreation areas were located on maps and then field-verified to establish viewpoints representing a full range of locations and types. Roadways studied include Bear Creek Road (USFS Rd. 278), Ramsey Creek Road (USFS Rd. 4781) and Libby Creek Road (USFS Rd. 231). Recreation areas and visitor destination points investigated included Howard Lake, Libby Creek Recreation Gold Panning Area, Horse Mountain Saddle, Great Northern Mountain, Snowshoe Peak, Bald Eagle Peak and Elephant Peak.

Noranda provided computer visibility maps to determine the visibility of the project components from each identified viewpoint. The viewpoint visibility matrix summarizes the distance and viewing angle of project components as expected to be seen from each viewpoint (Table 4-38).

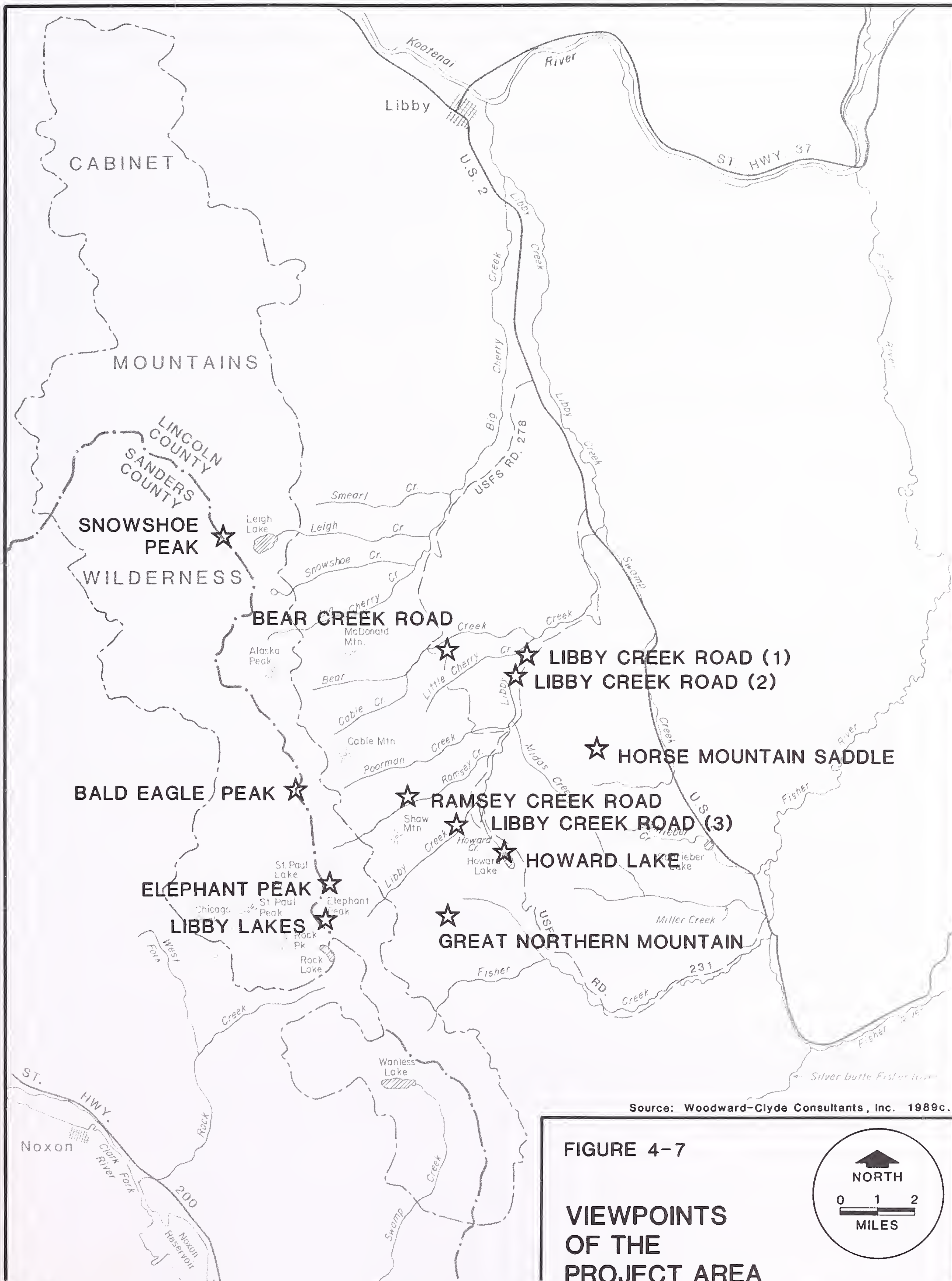
Plant Site

The plant site would be fully visible in the middleground from the Elephant Peak viewpoint and would significantly affect the view from the peak. Appendix D contains a visual simulation of the view from Elephant Peak. The effect of the plant on the view is compounded by the long view duration, the lack of a foreground view and the high view angle. Although Elephant Peak is within the Cabinet Mountains Wilderness, viewing significance is low. It is a destination peak for a few wilderness visitors.

The visual quality objective (VQO) under KNF's Forest Plan for the proposed plant site is retention. Activities appropriate for a retention VQO "may only repeat form, line, color and texture which are frequently found in the characteristic landscape." The proposed plant would not meet this objective.

Two additional viewpoints that would be marginally affected by the plant are Horse Mountain Saddle and Ramsey Creek Road. Although the plant site could be seen from Horse Mountain Saddle, the long view distance and the high visual absorption capability would reduce the visual impacts. The mill, however, may affect foreground views from Ramsey Creek Road because of facility height, but should be only marginally visible because of the dense vegetation and low view angle obscuring most or all of the proposed mill.

The visual impacts of the plant site would occur throughout the life of the project. Following reforestation (20 to 30 years), the impacts would be significantly reduced. The proposed revegetation plan would return the site to near its original texture and color. The disruption of the Ramsey Creek



Source: Woodward-Clyde Consultants, Inc. 1989c.

FIGURE 4-7

VIEWPOINTS OF THE PROJECT AREA

valley's form by the cut-and-fill slopes of the plant site would continue to be visible from Elephant Peak for a number of years following operations.

Land Application Disposal Area

The land application disposal (LAD) area would be visible from a number of viewpoints, including Bald Eagle Peak, Great Northern Mountain and Horse Mountain Saddle. The three viewpoints analyzed have a high view angle to the LAD area. The viewing significance of all three viewpoints is low. The visibility of the LAD area from these three viewpoints would be reduced by the long viewing distance. Horse Mountain would be about four miles away from the percolation pond area and Great Northern Mountain and Bald Eagle Peak would be about eight to ten miles away. With the exception of Horse Mountain Saddle, the LAD area would be in a

Table 4-38. Possible views of mine facilities from designated viewpoints.

Viewpoint	Plant site	Land application disposal area	Tailings impoundment	Bear Creek Road	Viewpoint angle
Cabinet Mountains Wilderness viewpoints					
Snowshoe Peak	∅	∅	❑	❑	H
Bald Eagle Peak	∅	❑	∅	❑	H
Elephant Peak	◆	❑	∅	∅	H
Libby Lakes	∅	∅	∅	∅	H
Other viewpoints					
Bear Creek Road	∅	∅	■†	∅	L
Great Northern Mountain	∅	❑	❑	∅	H
Horse Mountain Saddle	❑	◆	◆	❑	H
Howard Lake	∅	∅	∅	∅	N/A
Libby Creek Road (1)	∅	∅§	■	∅	L
Libby Creek Road (2)	∅	∅§	■	∅	L
Libby Creek Road (3)	∅	∅	∅	∅	L
Ramsey Creek Road	❑†	∅	∅	∅	L

View distance

■ Foreground view (<than 1/2 mi)

◆ Middle ground view (1/2 to 3 mi)

❑ Background view (>than 3 mi)

∅ Not visible

Viewpoint angle

H High—Views would look down on proposed facilities

L Low—Views of proposed facilities are at about eye level

†Extent of visibility uncertain

§Visibility maps prepared by Noranda indicate the facility area would be visible for the particular viewpoint; dense vegetation and low view angle would likely obscure views of proposed facilities

Source: Woodward-Clyde Consultants, Inc. 1989c.

background view and may even be obscured by dense vegetation and landforms. The duration of the view could be a factor from Bald Eagle Peak and Great Northern Mountain, but it should be mitigated due to the panoramic quality of the views from these points.

The visual absorption capability for the LAD area is moderate to high, reflecting a good ability to absorb visual change. The VQO is maximum modification. Any clearing of trees in the area should be similar to the existing patterns created by timber harvesting in the area and would meet the visual objective.

Two viewpoints along Libby Creek Road, located about four to five miles away at the same relative elevation as the LAD area also could be affected. Due to the dense growth of trees and the low view angle, neither viewpoint likely would be affected significantly.

Tailings Impoundment

The tailings impoundment, located in the Little Cherry Creek drainage, would be visible from five of the identified viewpoints, (two on Libby Creek Road, and one each on Horse Mountain Saddle, Great Northern Mountain, and Snowshoe Peak). Appendix D contains a visual simulation of the view from Libby Creek Road. Because of a high view angle, the view from Horse Mountain Saddle would incur the greatest impact by the tailings impoundment. From that viewpoint, the viewer would have a direct, uninterrupted, middleground view of the disturbance. Although the viewpoint has low viewing significance, the potential for long view duration and quality views exist because of the viewpoint's location.

Of the five viewpoints affected, two are destination peaks, Great Northern Mountain and Snowshoe Peak. Great Northern Mountain has low viewing significance; Snowshoe Peak, located in the Cabinet Mountains Wilderness, has moderate viewing significance. From these viewpoints, the impoundment would be located in the background (more than 10 miles away) and may be obscured by landforms.

Two viewpoints along Libby Creek Road (1 and 2 on Figure 4-7) are relatively close together and would be affected significantly by the form and mass of the proposed impoundment dam. Libby Creek Road has moderate viewing significance. The view from Libby Creek Road would be near the same elevation as the tailings impoundment, eliminating the possibility of seeing the total impoundment site. The only visible portion of the impoundment would be the dam. As a result of timber harvesting adjacent to the road, numerous small openings would provide a view of the impoundment dam. View duration would be long due to the number of openings and the viewer's attention being focused toward the Cabinet Range. Bear Creek Road also has a viewpoint located near the impoundment. As the tailings impoundment increases in size, it may become more noticeable from this viewpoint.

The visual absorption capability of the proposed impoundment area is moderate, reflecting a moderate ability to absorb visual change. Because of the proposed impoundment size, very little can be done to reduce the visual impact, particularly for high view angles. The visual quality objective is modification. The impoundment would not use naturally established form, line and color, and would not meet the VQO of modification.

The visual impacts of the impoundment would occur throughout the life of the project. Following reclamation, the impacts would be reduced significantly. The proposed revegetation plan would return the site to near its original texture and color. The impoundment would interrupt the present form of the Little Cherry Creek drainage.

Bear Creek Road Improvements

The Bear Creek Road improvements would be visible from three viewpoints (Snowshoe Peak, Horse Mountain Saddle, and Bald Eagle Peak). Because of a high view angle, the potential to see

these road improvements is possible. However, from these viewpoints, Bear Creek Road is located in the background view (more than 10 miles away) and may be obscured by dense vegetation and landforms. The Bear Creek Road improvement would not significantly affect the visual quality from the identified viewpoints. Proposed reclamation following road improvements would decrease the visual effects from other viewpoints.

Transmission Line Corridor

Alternative 1 would result in 1.7 miles of high visual impact, 5.3 miles of moderate impact, 6.8 miles of low impact, and 2.5 miles of very low impact (Table 4-39; Figure 4-8). Of the four transmission line route alternatives, it would result in the most visual impact.

High and moderate visual impacts would be common along U.S. 2 between the proposed substation and the point where the line would enter the Miller Creek drainage. Proximity to residences and high levels of visibility from the highway contribute to these impact levels.

Visual impacts in the Miller Creek drainage would be low. The Miller Creek drainage is a moderately used, dispersed recreation area having lower viewer sensitivity than the U.S. 2 corridor or the Howard Lake and Libby Creek areas. Impacts would be low for the portion of the line closely paralleling USFS Rd. 4724. Portions of this corridor would be visible from the road as the road ascends the south side of the drainage. Impacts would be low in upper Miller Creek where the line and associated right-of-way clearing would be screened from most viewpoints within the drainage.

This alternative would result in moderate visual impact between Libby Divide Trail and Ramsey Creek. This area is more heavily used for recreation than the Miller Creek area. It includes two recreation sites, Howard Lake Campground and the Libby Creek Recreation Gold Panning Area, and provides access to four trail heads.

The visibility of the proposed transmission line from wilderness viewpoints contributes to higher impacts. Steep hillsides covered with dense forest growth have a moderate-to-low capability to screen the transmission line.

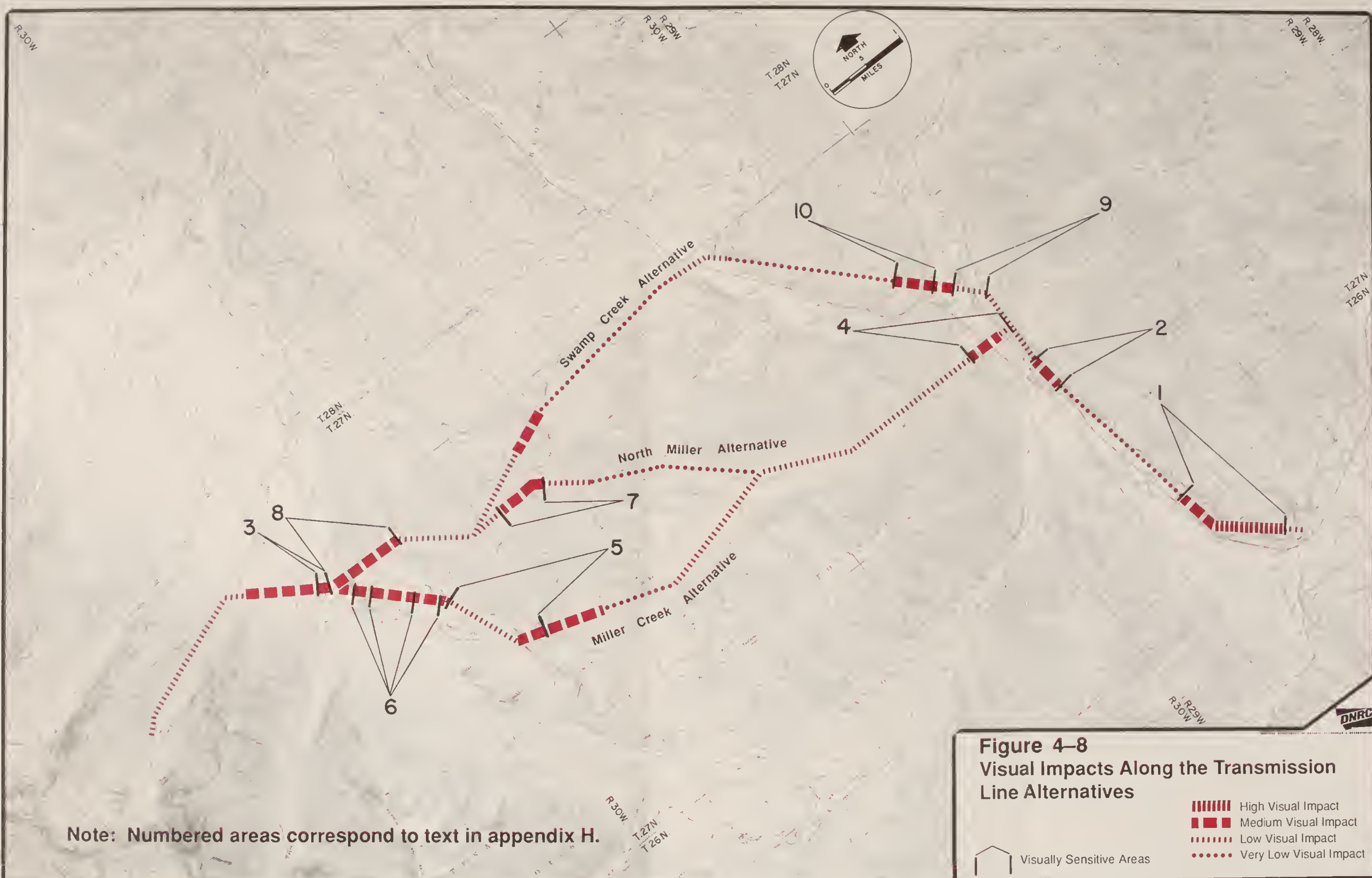
Moderate visual impacts would result where this alternative crosses the Libby Divide and Miller Creek trails and passes by Howard Lake. Visibility of the transmission line from the trails, Howard Lake, and USFS Road 231 contributes to the visual impact.

Visual impact near Howard Creek would be low when topography is relatively flat, and the area landscape is better able to absorb impacts of the new line. High visual impacts would occur where this

Table 4-39. Visual impacts of the transmission line routes.

Visual impact category	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	miles			
High	1.7	1.5	1.5	1.7
Moderate	5.3	5.2	4.7	4.6
Low	6.8	7.2	7.9	4.3
Very low	2.5	2.5	1.8	6.6
Total	16.3	16.4	15.4	17.2

Source: Department of Natural Resources and Conservation. 1990.



Note: Numbered areas correspond to text in appendix H.

Figure 4–8
Visual Impacts Along the Transmission Line Alternatives

route crosses the developed area at the Libby Creek Recreation Gold Panning Area.

The portion of this alternative which follows Ramsey Creek to the plant site would have low visual impact. The proposed transmission line would be located next to the access road and tailings pipelines through this narrow canyon. Visibility would be limited to the wilderness viewpoint near Elephant Peak area at the head of the drainage. The transmission line would generally meet the visual quality objectives of Partial Retention and Modification, but would have difficulty meeting a Retention objective.

Substation, Microwave Repeater Station, and Receptor

The proposed substation at Sedlak Park would have low visual impact. Vegetation clearing and ground leveling would disturb about 1 acre. Five large ponderosa pines near the highway would not be cleared. Views of the substation by highway travelers would be of very short duration due to topographic (landform) and vegetative screening. The Manicke Community Church across U.S. 2 from the proposed site would have a direct view of the substation in the immediate foreground. The substation would be a dominant element in the landscape viewed from the church because of its size, scale and proximity.

Location of the microwave repeater station on a ridgeline about 3 miles west of the substation (see Figure 2-1 in Chapter 2) would make it visible from some viewpoints in the Fisher River valley. Proposed construction and mitigation measures would greatly reduce the visual impact of this facility. These measures would include helicopter construction to minimize ground disturbance, no access road construction, and painting or other treatment of the microwave reflector to help it blend with the surrounding landscape and vegetation.

Impacts from the microwave repeater station on views from the Barren Peak lookout tower cannot be fully evaluated without an on-site survey prior to final design, but the impacts would be the same for all alternatives. Tentative location of the repeater station would be about 0.75 miles northeast of the lookout. Because of this distance, impacts would be low to moderate depending on several conditions. Impacts might be affected by the presence or absence of vegetative screening around the repeater site, the area of disturbed ground, and the "billboard" surface visible from the lookout tower. Several measures would be used to reduce visibility to this site, including using a helicopter to minimize site disturbance during construction, prompt revegetating of disturbed areas, and painting the repeater station facilities to blend with the viewed landscape.

The proposed substation at Sedlak Park would be visible to highway travelers, though views would be of very short duration. Topography and vegetation at the proposed substation site screen long distance views from U.S. 2, providing only limited views of short duration as highway travelers pass by. The substation also would be visible from the Manicke Community Church directly across U.S. 2 from the proposed site.

ALTERNATIVE 2

Noranda would implement several practices to reduce visual impacts. Earth-tone paints would be used at the facilities, reducing the visual contrast with the existing vegetation. Waste rock piles and LAD area would be located to minimize impacts to visual resources.

Noranda would undertake a roadside tree management program to obscure any project facilities viewed from travel routes. The tailings impoundment would be visible from some viewpoints along the Libby Creek and Bear Creek roads.

Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternative 1.

ALTERNATIVE 3

Alternative 3A may reduce the visual impacts associated with the LAD area, since land application may not be necessary. The site would not be visible from the Bald Eagle Peak and Elephant Peak viewpoints within the Cabinet Mountains Wilderness. Alternative 3C would include additional LAD areas in the Little Cherry Creek area. These areas probably would not be noticeable in comparison to the tailings impoundment. Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternative 1 and 2.

IMPACTS COMMON TO ALTERNATIVES 4, 5 AND 6

Figure 4-8 shows areas of visual impacts along the centerlines. Appendix H discusses visually sensitive areas identified along the alternative routes where review of final design plans and proposed clearing requirements would be conducted by the DNRC and the KNF.

The proposed substation at Sedlak Park would have low visual impact. Vegetation clearing and ground leveling would disturb about one acre. Five large ponderosa pines near the highway would not be cleared. Views of the substation by highway travelers would be of very short duration due to topographic (landform) and vegetative screening. The Manicke Community Church across U.S. 2 from the proposed site would have a direct view of the substation in the immediate foreground. The substation would be a dominant element in the landscape viewed from the church because of its size, scale and proximity.

Location of the microwave repeater station on a ridgeline about three miles west of the substation (see Figure 2-1 in Chapter 2) would make it visible from some viewpoints in the Fisher River valley. Proposed construction and mitigation measures would greatly reduce the visual impact of this facility. These measures would include helicopter construction to minimize ground disturbance, no access road construction, and painting or other treatment of the microwave reflector to help it blend with the surrounding landscape and vegetation.

Impacts from the microwave repeater station on views from the Barren Peak lookout tower cannot be fully evaluated without an on-site survey prior to final design, but the impacts would be the same for all alternatives. Tentative location of the repeater station would be about 0.75 mile northeast of the lookout. Because of this distance, impacts would be low to moderate depending on several conditions. Impacts might be affected by the presence or absence of vegetative screening around the repeater site, the area of disturbed ground, and the "billboard" surface visible from the lookout tower. Several measures would be used to reduce visibility to this site, including using a helicopter to minimize site disturbance during construction, prompt revegetating of disturbed areas, and painting the repeater station facilities to blend with the viewed landscape.

ALTERNATIVE 4

The proposed centerline for Alternative 4 would result in 0.7 mile of high visual impact, 4.3 miles of moderate impact, 9.0 miles of low impact, and 2.7 miles of very low impact (Table 4-39). Visual impacts for Alternative 4 would be similar to those of Alternative 1. Adjustments to proposed line location at the Libby Creek Recreation Gold Panning Area to cross this site at a different location and at the U.S. 2 crossing to avoid close proximity to residences would result in less visual impact than Alternative 1. Portions of the line along U.S. Highway 2 would be less visible from the highway and residences would have low or very low impact.

Impact would be low for a 0.9-mile segment of line above Howard Lake where trees would screen views from Howard Lake and from USFS Road 231. Clearing along this segment probably would extend outside the 100-foot right-of-way because the trees

along the line are approximately 150 to 200 feet high, but trees not cleared would screen views of the line.

Impact would be moderate up to the point where the line would enter the Ramsey Creek drainage. Between angle points near Howard Lake and the Libby Creek Recreation Gold Panning Area, the line would cross USFS Road 231 five times, and these crossings, along with views of the line from recreation trails and wilderness viewpoints, would cause moderate visual impacts.

ALTERNATIVE 5

The proposed centerline for this alternative would have 0.7 mile of high visual impact, 4.1 miles of moderate impact, 7.8 miles of low impact, and 3.7 miles of very low impact (Table 4-39). This alternative would have the same location and same impact as Alternative 4 along U.S. 2 in lower Miller Creek and from the Libby Creek Recreation Gold Panning Area to the plant site.

Where this alternative diverges from the proposed line in Miller Creek, impacts would be very low as visibility of the line decreases to very low levels. The line would become more visible as it approaches the North Fork Miller Trail and Libby Divide Trail. Impact levels would increase to moderate as the line approaches the Libby Divide Trail at the ridgeline. Access road construction and location of structures would make this alternative highly visible near the ridgeline.

Dispersed recreation use is low in the Midas Creek drainage. Within this area, impacts would be moderate near the Libby Divide Trail. Impact levels then decrease to low as visibility is limited to viewpoints in the drainage and views from Horse Mountain about 1.5 miles to the north.

Impacts would be moderate where this alternative leaves the Midas Creek drainage and descends toward Libby Creek. The line would cross areas used more heavily for recreation when compared to the Midas Creek drainage. Right-of-way clearing would make the line's location visible from wilderness viewpoints. This alternative is identical to Alternative 4 from the Libby Creek Recreation Gold Panning Area to the proposed plant site.

ALTERNATIVE 6

The proposed centerline for this alternative would result in 0.7 mile of high visual impact, 4.4 miles of moderate impact, 6.2 miles of low impact, and 6.0 miles of very low impact (Table 4-39). This centerline would have the same location and same impact as Alternatives 4 and 5 along U.S. 2 and from the Libby Creek Recreation Gold Panning Area to the plant site. This alternative parallels the highway for approximately 4 miles beyond the point where the proposed location bends to the west. Impacts would be very low for most of this length because the line would be screened from view by topography and vegetation. Greater distance between a residence and the line at the Fisher River crossing (approximately 0.25 miles compared to 0.1 mile) would decrease expected impact from high to moderate. The line would be visible to highway travelers where it crosses U.S. 2, but visual impacts would be low.

Impact would be very low in the Swamp Creek drainage due to low levels of recreation use and the existing landscape character. Extensive timber harvesting in this area would decrease right-of-way clearing requirements but increase structure visibility.

Like Alternative 5, this alternative would have moderate impact where it crosses the Libby Divide Trail. Impact would be low in the Midas Creek drainage. This alternative is identical to Alternative 5 from the head of Midas Creek to the proposed plant site.

CUMULATIVE IMPACTS

Timber harvesting has affected the visual quality of the project area. Nearly 25 percent of the area has been subjected to timber harvesting over the past 20 years. Additional timber harvesting is projected to occur. Although views from travel routes are less

affected, views in the Cabinet Mountains have been significantly affected by timber harvesting activities. During the life of the project, the visibility of surface facilities as previously described would contribute to the developed nature of the landscape. Eventual reclamation of the Montanore Project would minimize long-term cumulative impacts to the visual resource, as would reforestation of clear-cut areas.

The ASARCO Rock Creek mine would not create any direct cumulative visual impacts to the study area. No viewpoints identified for the Montanore Project would be within view of the ASARCO mine. Some indirect impacts may occur. Some viewpoints in the Cabinet Mountains Wilderness would be affected by the ASARCO mine.

RESOURCE COMMITMENTS

The project would be visible from a number of viewpoints, both in the Cabinet Mountains Wilderness and within KNF. The visual impact of the tailings impoundment, transmission line, and the plant would significantly affect some forest users. Although the proposed revegetation plan would, when fully successful, serve to decrease the visual effects of many of the proposed mine components, the tailings impoundment site would always remain incongruent with the surrounding landscape. Development of the project would be an irreversible commitment of these visual resources.

ALTERNATIVE 7

Not building the proposed mine facilities and transmission line would maintain the existing visual character of the area. The landscape would continue to undergo modifications associated with timber harvesting, road building, and other activities.

TRANSPORTATION

SUMMARY

Under Alternative 1, employee and mining vehicles would significantly increase traffic levels on the Bear Creek Road. Congestion on U.S. 2 and USFS roads 278, 2317 and 4781 would be minimal if planned improvements by the Montana Department of Highways and Noranda are completed. Traffic from the proposed project would not significantly affect the load-carrying capacity of the roadway surfaces or structures. Because the proposed Bear Creek access road width is narrow, disabled trucks might present a safety problem. Depending on peak hour traffic volumes, the intersection of U.S. 2 and the Bear Creek road could be congested. A safety hazard could exist for the vehicles on the Bear Creek Road turning north onto U.S. 2 toward Libby.

Through a proposed transportation plan, Alternatives 2 and 3 would result in significantly lower vehicle trips per day on roads used for mine access. Planned Montana Department of Highways improvements to U.S. 2 would not be needed until the year 2009 to achieve an acceptable level of service. Additionally, any congestion at the intersection of U.S. 2 and Bear Creek Road resulting from the project would be reduced.

Impacts associated with Alternatives 4 and 5 would not be different from those associated with Alternative 1. With Alternative 6, short-term construction impacts on U.S. 2 traffic would be similar to Alternative 1, although these effects would occur in a different location. Under the no action alternative (Alternative 7), increased traffic levels and accidents would not occur.

ALTERNATIVE 1

Traffic Congestion

Traffic impact assessment requires selecting a desired level of service (see Chapter 6, Methods). Since the proposed project would be in a rural environment, level of service C is used as a minimum level of service considered acceptable. Level of service C results in the average speed being five miles per hour less than the posted speed; oncoming traffic also impedes passing. Impacts are considered unacceptable if increased project traffic would result in a level of service below level C.

U.S. 2. Where it exists as a two-lane rural highway, U.S. 2 is capable of carrying about 610 vehicles per hour and maintaining a level of service C. The daily traffic flow on the two-lane portion of U.S. 2 was 3,149 vehicles in 1988, and traffic is projected to increase to 3,880 vehicles in the year 2008, without the project-related traffic. These volumes translate into 470 vehicles per hour in 1988 and 500 in 2008 during the peak hour. These volumes would allow U.S. 2 to continue operating at a level of service C without the proposed project traffic.

When estimated traffic levels resulting from the Montanore Project are added to the baseline condition, 730 vehicle per hour would occur in the peak period in 2008. The 2008 estimated peak hour volumes would exceed the level of service C. It is estimated that U.S. 2 would reach its level of service C in about 1995. These calculations are based on the existing cross-section of U.S. 2. The Montana Department of Highways is in the process of improving the highway by adding shoulders. Following completion of improvements, the highway would operate at an acceptable level of service.

Access roads. Noranda would upgrade the Bear Creek Road from U.S. 2 to the Bear Creek Bridge and relocate and reconstruct the Bear Creek Road from the bridge to the proposed plant site. During the 1.5-year construction period, the Libby Creek Road would likely be used for construction traffic. Traffic volumes on the Bear Creek Road would increase 530 percent, from 135 vehicles per day in 1990 to 850 vehicles per day in 2008. Improvements proposed by Noranda would allow the Bear Creek Road to operate at an acceptable level of service during the life of the project. Similar increases would occur on the Libby Creek Road during the construction phase.

U.S. 2 and access roads intersections. Some increased congestion may occur at the U.S. 2 and Bear Creek Road intersection and the Libby Creek Road and U.S. 2 during the construction phase. The amount of congestion would depend on the amount of traffic occurring at peak hour level.

The ore concentrate trucks would use a private haul road. No information is available on the private haul road, so the adequacy of the road's capacity could not be assessed. Noranda anticipates some work would be required on the road.

Transmission line construction is expected to cause little additional traffic impact on U.S. 2. Some minor, short-term increases in construction traffic can be expected along U.S. 2 south to the Sedlak Park substation site. Increases in traffic and minor disturbances of traffic flows might result as construction traffic leaves U.S. 2 to other roads during construction and when construction across the highway occurs. Because of construction traffic, minor inconvenience and delays can be expected for logging and recreational traffic using forest service and Champion roads in construction areas. Any construction activity that would affect highway traffic or traffic along the Miller Creek road would require proper signing and other measures as required by the Montana Department of Highways and the KNF (Appendix F).

Road closures. Noranda has proposed several road closures as part of the grizzly bear mitigation plan. These road are used primarily by recreational users and the proposed closures would not affect traffic patterns in the area.

Safety

Additional traffic on U.S. 2 and the Bear Creek Road would result in additional accidents. About 14 accidents per year occur on U.S. 2 between the Bear Creek Road and Libby. Almost all of these accidents are severe. The traffic from the proposed project would result in an additional 2.5 accidents per year, or an 18 percent increase over the current condition.

A safety hazard would exist for vehicles turning left from the Bear Creek Road onto U.S. 2 toward Libby. Vehicles making this turn would be crossing the south-bound lane of U.S. 2 and merging into the north-bound lane of U.S. 2 which has a posted speed of 55 mph. A similar hazard would exist during the construction phase at the Libby Creek Road and U.S. 2 intersection.

No information is available for past accident rates on the proposed access road, but it is assumed low. Given the projected traffic increase on the proposed access road, the number of accidents would be expected to increase by a factor of about five. Since the number of accidents now occurring on this road is probably low, the projected increase would not be a significant impact. Due to the low speed limit on these roads, most of these accidents should not be severe.

Because of the narrowness of the Bear Creek and Libby Creek roads, a large disabled truck would create a hazard. This hazard could occur in portions of the roads where sight distance would not be adequate to permit passing vehicles to see on-coming vehicles.

Load Carrying Capacity

The proposed project would not significantly affect the carrying capacity or surface condition of U.S. 2. All structures on U.S. 2 and the Bear Creek Road are structurally rated to carry the proposed loads. Noranda has said that overweight (greater than 80,000 pounds) vehicles would not be used except to transport very large equipment. Such loads would be subject to review and permitting by the KNF and the Montana Department of Highways.

ALTERNATIVES 2 AND 3

Noranda would develop a transportation plan for the construction and operation phases of the project. The goal of the plan would be to reduce daily vehicular trips by employees. This alternative assumes that about 50 percent of the employees would use a mass transit system (such as buses) and the remainder would participate in an increased level of ridesharing (50 percent increase over the base condition). This alternative would result in 169 fewer vehicle trips per day, 75 for the day shift, 47 for the swing shift, and 47 for the graveyard shift. This measure, however, would adversely affect the load carrying capacity of U.S. 2 as a result of the bus traffic. This impact would not be significant.

The improvements tentatively planned by the Montana Department of Highways would not be required to achieve an acceptable level of service on U.S. 2 through the year 2008. If the improvements are made by the Montana Department of Highways, the level of service would be above the desired level C for a rural environment. Congestion at the intersection of U.S. 2 and the Bear Creek Road would be reduced, allowing the intersection to operate at an acceptable level of service. Fewer accidents would occur on U.S. 2 and the Bear Creek Road.

Noranda would restrict ore concentrate trucks from the access road during shift change periods when a large number employees would be traveling the access road. This would decrease the accident rate on the Bear Creek Road and U.S. 2 and decrease congestion at the Bear Creek Road and U.S. 2 intersection.

Noranda would equip all concentrate trucks with radios to provide communication in the event of a breakdown. Warning signs for oncoming traffic

would be posted near any disabled truck. This measure would help reduce the safety hazard.

One option under Alternative 3 would require mechanical treatment of excess water before, during, and after operations. A slight increase in traffic over that projected under Alternative 1 would occur.

ALTERNATIVES 4 AND 5

Alternatives 4 or 5 would not affect the overall transportation impacts described under Alternative 1.

ALTERNATIVE 6

Alternative 6 would move the points of construction access and the crossing of U.S. 2. Construction traffic would leave U.S. 2 at the Schrieber Creek and Coyote Creek roads. Short-term construction impacts on highway traffic would be similar to those under Alternative 1, with the difference being a change in location. Minor inconveniences and delays might occur for logging and recreational traffic using National Forest System or Champion roads in construction areas.

CUMULATIVE IMPACTS

Traffic from the proposed Rock Creek Mine would not affect any of the transportation network affected by the proposed Montanore Project. Only a small increase in Lincoln County population is expected from the proposed Rock Creek Project. Consequently, no cumulative transportation impacts from these two projects would be anticipated.

Traffic associated with timber harvesting would not reduce the level of service on the access road, U.S. 2, or the Bear Creek Road/U.S. 2 intersection. Logging traffic would cause an insignificant increase in wear on U.S. 2.

The Montana Department of Highways is planning construction activities on U.S. 2 between Libby Creek and the Miller Creek/Fisher River area. If this proposed activity is conducted concurrently with Montanore Project construction, a reduced level of service than that described may occur.

RESOURCE COMMITMENTS

There would be no irreversible or irretrievable commitments of transportation resources. Increased traffic associated with the project would cease after project completion.

ALTERNATIVE 7

Increased traffic levels and accidents would not occur. Planned improvements to U.S. 2 by the Montana Department of Highways would not be necessary.

SOCIOECONOMICS

SUMMARY

Under base case Alternative 1 assumptions, population migration into the study area would peak at about 411 in 1995. This would be an increase of slightly over two percent above the 1990 Lincoln County population level. The long-term population increase would be an estimated 319 people from 1996 through 2011. Most of these would live in Libby or in rural Lincoln County near Libby. The project would generate an estimated $13.82 million in annual direct and indirect income during full-scale operations.

The larger population would increase the need for community services, primarily law enforcement personnel and teachers. The availability of affordable housing would likely be the biggest concern for in-migrating families.

Project development would result in increased tax revenues and costs to local governments. Noranda would pay for all increased public capital and net operating costs created by the project. Jurisdictions which are projected to have increased tax revenues and cost include Lincoln County, Libby, and the Libby Elementary and High School Districts. Sanders County and the Noxon School District also would receive tax revenues due to the terms of H.B. 832.

Under the other action alternatives, projected socioeconomic impacts would be the same as in Alternative 1. Under the no action alternative (Alternative 7), the economic development benefits from 450 jobs during operations, 190 jobs during construction, and $13.82 in annual income associated with long-term operations would not occur.

ALTERNATIVE 1

Project-Related Employment

Primary factors affecting the timing and magnitude of socioeconomic impacts are—

- project hiring schedule;
- the existence of a locally available workforce; and
- the need for additional workers (and their dependents) to migrate to the area.

Noranda has prepared employment estimates for project construction and operations phases (Table 4-40). Construction would commence during the third quarter of Year 1 (assumed in this analysis to be 1993) with the hiring of about 150 employees, and would last approximately 2.5 years. Construction employment would peak at 190 employees during the third quarter of Year 2 (1994). By Year 3 (1995), peak construction employment would decline to fewer than 100 employees.

Upon completion of surface plant construction and underground construction and development, the mine/mill complex would be brought up to full production during a 3-to-12-month period. By the beginning of Year 3 (1995), operations employment would reach an estimated 440, ten employees below the full-scale operations workforce of 450 in Year 4 (1996). The peak operations workforce would remain at 450 through the life of the mine, anticipated to be 16 years (through 2011). Total employment (construction and operations) is expected to peak at 530 employees during the third quarter of Year 3 (1995). Actual employment may vary from the estimates, depending on timing of initial construction, progress of construction, and timing of full-scale operations.

It is assumed that 45 percent of the construction workforce would come from existing residents of the Libby/Troy area. This assumption includes the possibility that a non-local construction contractor would be hired and would bring employees from outside the area. A local hiring ratio of 80 percent has been assumed for post-construction operations. This assumption is based on Noranda's hiring experience at other projects, on local hiring ratios for other energy and mineral developments in Montana, Wyoming, and North Dakota, and on the number of qualified workers who filled out applications at the Montana Job Service Office in Libby (Table 4-41). If conditions were to change, or if Noranda were to recruit non-residents, the hiring ratios for the Montanore Project could change (see the *Assumption Sensitivity Analysis* section later in this chapter).

Table 4-40. Estimated Montanore Project employment—construction and operations.

	Year 1				Year 2				Year 3				Years 4-15
Employment by type	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	All Quarters
Construction employment													
Administrative	0	0	15	10	10	10	15	10	5	5	5	5	0
Technicians	0	0	15	10	10	10	15	10	10	10	5	0	0
Mechanics	0	0	30	70	20	20	50	70	50	50	30	20	0
Equipment operators	0	0	60	60	50	70	80	60	5	5	40	20	0
Laborers	0	0	30	20	20	20	30	20	10	10	10	10	0
Subtotal	0	0	150	170	110	130	190	170	80	80	90	55	0
Operations employment													
Administrative	15	15	15	15	15	15	15	15	20	20	20	20	25
Technicians	15	15	15	15	15	15	15	15	20	20	20	20	25
Mechanics	0	0	0	0	20	20	20	20	90	90	90	90	90
Equipment operators	0	0	0	0	60	60	60	60	220	220	220	220	220
Laborers	0	0	0	0	20	20	20	20	90	90	90	90	90
Subtotal	30	30	30	30	130	130	130	130	440	440	440	440	450
Total project employment	30	30	180	200	240	260	320	300	520	520	530	495	450

Source: Noranda Minerals Corp. 1989a. p. 27-a.

Table 4-42 is an estimate of local hiring ratios by employee type. The figures in Table 4-41 and 4-35 indicate that Noranda would need to hire about 89 percent of the available equipment operators, 18 percent of the available technicians, and about 13 percent of available laborers from the local work force. Other possibilities for local hiring include people currently employed at ASARCO's Troy Mine (see the *Cumulative Impact* section), and unskilled workers who could be trained.

Table 4-41. Libby Job Service applicants from July, 1988 through June, 1989.

Occupation category	Number of applicants Maximum	Minimum	Average
Equipment operators	250	167	202
Mechanics	61	39	46
Technicians (mine-related)	145	99	112
Laborers	733	510	633
Other	227	141	176

Source: Noranda Minerals Corp. 1989d. p. 61.

Table 4-42. Estimated local hiring ratios by employee type.

Phase/Position	Peak employment	Expected local hire Number	Percent
Construction			
Administration	15	3	20
Equipment operators	80	32	40
Mechanics	50	19	38
Technicians	15	5	33
Laborers/other	30	27	90
Total	190	86	45
Operations			
Administration	25	15	60
Equipment operators	220	180	82
Mechanics	90	55	61
Technicians†	25	20	80
Laborers/other	90	90	100
Total	450	360	80

Source: Noranda Minerals Corp. 1989d. p. 60.
†Technicians include lumbermen, welders, firemen, machinists, electricians, warehousemen, carpenters, and janitors.

Indirect Employment

Growth in basic industry (such as a mining operation) usually creates indirect employment opportunities, primarily in the service and retail trade sectors (e.g., restaurants, retail stores, etc.). It is estimated that each new construction job would lead to 0.3 new indirect employment opportunities, and each new mining job would lead to 0.45 new indirect employment opportunities. These multipliers were chosen on the basis of recent experience in Montana where residents made many major purchases outside the study area (Economic Consultants Northwest, 1989). The multipliers do not reflect any major funds spent by Noranda in the study area. Additional employment could be created if Noranda spends substantial funds on materials and other goods and services within Lincoln County. As the area grows and/or becomes more self-sufficient, these indirect employment multipliers might increase (see *Assumption Sensitivity Analysis* section).

It is estimated that 50 percent of the indirect employment resulting from the proposed project would occur in the same year construction and mining employees are hired, with the remaining 50 percent occurring the following year. Peak indirect employment from project development is estimated to be 210 persons in 1996. It is estimated that 90 percent of indirect employees would be hired from the existing local labor force, yielding a peak indirect worker in-migration of 21 persons in 1996.

Table 4-43. Estimated annual payroll.

Project year	Calendar year	Total payroll (1989 $)	Average salary (1989 $)
1	1993	2,930,000	26,636
2	1994	7,465,000	26,660
3	1995	13,760,000	26,654
4+	1996	12,000,000	26,666

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-27-a.

Demographic Characteristics of Employees

Some in-migrating employees would have spouses or other dependents. It is assumed that 60 percent of in-migrating construction and indirect employees would be married, and that each in-migrating couple would have an average of 0.83 children (aged 0-18 and living at home). This would mean an overall family size of 2.1 people per in-migrating construction or secondary worker.

It is assumed that 80 percent of in-migrating operations workers would be married, and that each married couple would have an average of 1.625 children. This yields an overall estimated family size of 3.1 people per in-migrating operations worker.

Of the in-migrating children, 45 percent are assumed to be attending school in grades kindergarten through 8th, 19 percent are assumed to be in high school, 35 percent are assumed to not be enrolled in school, and 1 percent is assumed to need special education.

Income Effects

Based on Noranda's estimated annual payroll, average income per worker would exceed $26,000 per year (Table 4-43). This would be consistent with existing mining wages in the area. Mining would continue to have the highest paying jobs in Lincoln County. Much of the income would be spent within the project area, thereby generating the indirect employment discussed previously. The indirect employment associated with the Montanore Project (peaking at 210 people in 1996 with a long-term indirect employment of 200 people) would lead to additional income in the project area. Assuming an average annual income of $9,100 for indirect workers, long-term income due to indirect employment would be $1.82 million. The estimated $13.82 million in long-term annual income attributable to the Montanore Project would be equivalent to 13 percent of total 1990 earnings in Lincoln County. The Montanore Project would

provide an important source of personal income over the next 20 years.

In addition to direct income effects, Noranda also may make substantial purchases of supplies and services. For example, the Troy Mine makes annual supply purchases of over $13 million (*The Western News*, October 18, 1989, p. 24). It is not known how much of this money is spent within the project area. Expenditures for the Montanore Project could be similar.

Population Effects and Settlement Patterns

Table 4-44 shows total estimated population effects directly associated with development of the proposed project. The peak population impact is estimated to occur in 1995, with 411 people projected to have migrated into the project area. Of these, about 50 would be construction workers, 88 would be operations workers, 17 would be indirect employees, 110 would be spouses, and 146 would be children. This would be a population increase of slightly more than 2 percent over the 1990 Lincoln County population estimate of 17,481 persons.

Upon completion of the project construction phase (1995), the long-term population effect of project development is estimated to be about 319 in-migrants by 1997. This would be a population increase of slightly less than 2 percent of the 1990 Lincoln County population. If construction worker in-migrants or transients seeking jobs decide to stay in the area, long-term population effects could be slightly higher.

Specific impacts to local government units within the project area depend upon where in-migrants choose to reside. Workers generally want to live close to the project site to reduce commuting distance, provided that adequate public services and housing are available. Expected settlement patterns of in-migrating population are given in Table 4-45.

Peak cumulative in-migration would occur in Libby in 1994, with 116 total people moving to Libby.

Table 4-44. Cumulative Montanore Project employment and population in-migration—Lincoln County.

Project year	1	2	3	4	5
Calendar year	1993	1994	1995	1996	1997
Project employment					
Construction	170	190	90	0	0
Operations	30	130	440	450	450
In-migrating population					
Construction employees	94	105	50	0	0
Operations employees	6	26	88	90	90
Indirect employees	3	9	17	21	20
Spouses	63	89	110	85	84
Children					
K–8	25	41	66	57	57
9–12	11	17	28	24	24
Not in school	20	32	52	45	44
Total	222	319	411	322	319

Sources: IMS Inc. and Noranda Minerals Corp. 1989a.

Peak cumulative in-migration into Troy and rural Lincoln County near Libby is expected in 1995, with 20 total people moving to Troy and 296 people moving to other Lincoln County areas (Table 4-46). Peak increases over 1990 population estimates for each area would be 4.6 percent in Libby, 2.1 percent in Troy, and 2.1 percent in other Lincoln County areas. By 1997, population increases due to development of the Montanore Project would be 50

Table 4-45. Expected settlement patterns.

Area	Construction (% of total in-migrating workforce)	Operations (% of total in-migrating workforce)
Libby	45	15
Troy	5	5
Rural Lincoln County	50	80

Sources: Economic Consultants Northwest, 1989 and IMS Inc.

people in Libby, 16 in Troy, and 256 in rural Lincoln County.

Community Services

Schools. The proposed project would affect schools in Lincoln County by increasing enrollment. Assuming that children in rural Lincoln County would reside in the Libby School District, peak additional enrollment in this district would be 91 children, occurring in 1995. Comparison of 1991-92 enrollment with these additional students is presented in Table 4-47. Forecast enrollment increases of 64 students in grades K-8 and 27 students in grades 9-12 would result in total estimated enrollment of 1,591 students in K-8 and 644 students in 9-12. This would still be below current school facility capacity, although elementary school facilities would be near its current capacity. While additional enrollment would maintain teacher/student ratios within Montana standards, local residents and school district administrators may wish to maintain the current quality of education by hiring additional teachers.

Table 4-47. Additional enrollment in Libby School District #4.

Grades	K-8	9-12
1991-92 enrollment	1,527	617
Peak additional enrollment (1995)	64	27
Percent increase	4.2	4.4

Source: IMS Inc. 1990.

Development of the proposed project would bring in an estimated four additional students by 1995 to the Troy School District #1. With current total enrollment (not including special education) of 677 students, the additional four students resulting from Montanore Project development would create minimal impact on the District.

Law enforcement. The projected increase in population would create increased demand on the Lincoln County Sheriff's Department—increased

Table 4-46. Peak cumulative in-migration—Libby, Troy, and other Lincoln County areas.

	Libby					Troy					Other Lincoln County areas				
Project year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Calendar year	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997
Construction employees	42	47	22	0	0	5	5	2	0	0	47	52	25	0	0
Operations employees	1	4	13	14	14	0	1	4	5	5	5	21	70	72	72
Indirect employees	1	3	4	4	3	0	0	1	1	1	2	6	12	17	16
Spouses	27	33	26	13	13	3	4	6	4	4	33	51	79	68	67
Children															
K–8	10	13	14	9	9	1	2	3	3	3	14	25	50	46	46
9–12	4	6	6	4	4	1	1	1	1	1	6	11	21	19	19
Not in school	8	10	11	7	7	1	2	3	2	2	11	20	39	36	36
Total	93	116	96	51	50	11	15	20	16	16	118	186	296	258	256

Source: IMS Inc. 1990.

traffic, vehicle accidents, and crime would create additional work for the officers. Law enforcement problems in the study area may result if transients migrate to the area seeking employment. Law enforcement officials have found that population in-migration tend to bring a significant increase in paperwork and problems arising from dogs (especially in rural areas).

Current law enforcement staff is considered inadequate. The effects of the Montanore Project would aggravate the existing situation. Additional law enforcement staff would be needed to increase law enforcement.

Increased project traffic on U.S. 2 would require increased law enforcement by the Montana Highway Patrol. Increased population would aggravate the capacity problem at the existing Lincoln County jail in Libby. The facility is often filled to its capacity of 24 inmates.

Fire protection. The Libby and Troy Volunteer Fire Departments would incur an increased demand on staff and equipment due to population increase. Existing staff and equipment in the project area are considered adequate. The expected new population would not be enough to cause any significant fire protection concerns.

Ambulance services. Volunteer Ambulance Services in both Libby and Troy would experience additional emergency calls resulting from traffic accidents on local roads with the projected increase in population and commuting project employees. An estimated additional 2.5 accidents per year could result from the project development (see the *Transportation* section for more information). While this increase in emergency calls would place an additional strain on the existing level of service, impacts are not expected to be increase ambulance requirements.

Hospitals and physicians. St. John's Community Hospital in Libby would experience a slight increase in admissions primarily because of traffic and project-related accidents. The hospital has adequate staff and facilities to meet this increased demand. The number of physicians in the area would be adequate to meet any increased demand resulting from project development.

Water supply. Approximately 2,000 households are currently served by the Libby water supply system. The estimated long-term increase of 17 households would be readily accommodated by the existing system. Outside of Libby, water is supplied by private wells. Ground water resources are adequate in existing residential areas near Libby to serve an estimated 88 additional households. However, water availability has not been proven for all potential residential locations.

Wastewater treatment. Since the Libby sewage treatment facility is currently operating at about 50 percent capacity, project related growth would easily be accommodated.

Residents in rural Lincoln County and Troy rely upon septic tanks for wastewater disposal. Potential problems due to construction and operation of new septic tank systems need to be evaluated on a case-specific basis.

Solid waste disposal. Residential and commercial refuse collection in Libby and Troy is handled by private contractors. Most refuse is disposed in a municipal landfill in Libby. With proposed expansion plans, the Libby landfill would have sufficient capacity to handle the additional population resulting from project development.

Human services. Transient job seekers moving to the project area might increase the number of welfare recipients. Existing personnel has difficulty in handling the current workload of welfare programs in the project area; additional demands would stress existing programs. The Montanore Project may offer employment opportunities to some persons currently using welfare and other human services, thereby reducing the current resident workload.

Libraries. Public library use in Libby and Troy would increase due to in-migration of new population. If the library receives additional funds to

meet the increased demand, no impacts should occur. If additional funds do not become available, there is the potential for changes in available library services.

Housing

The peak housing demand resulting from the Montanore Project would occur in 1995, when an estimated 155 construction, operations, and indirect workers would migrate into Lincoln County. Of these, 39 employees are projected to reside in Libby, seven in Troy, and 107 in rural Lincoln County, primarily near Libby. Assuming that each in-migrating worker represents one new household in the project area, Table 4-48 presents the number of total peak housing units needed by each category of workers.

The distinction between the types of workers is important because in-migrating construction workers tend to be more transient, and more generally require housing types such as apartments, mobile homes, or motel rooms. Operations and indirect workers tend to be more permanent, and more of these workers would make larger investments in housing, such as purchasing single family homes.

While the housing market is constantly changing, rental housing such as apartments, motel rooms, and single-family homes have generally been in short supply in the study area in recent years. Without additional housing, it is expected that in-migrating workers would reside primarily in existing mobile homes and single-family homes obtained through purchase. Many operations workers would be able to afford home purchases with projected income levels. Construction workers and indirect workers would add to the existing competition for rental housing units. It is anticipated that a mobile home park or apartment building probably would be developed in the study area to meet possible housing shortfalls, especially during the construction period. At present, Noranda is not considering a construction camp for workers.

Table 4-48. Worker residency patterns and housing needs.†

Worker type	Libby	Troy	Rural Lincoln County	Total	Peak year
Construction	47	5	52	104	1994
Operations	14	5	72	91	1996+
Indirect	4	1	17	22	1996

Source: IMS Inc. and Noranda Minerals Corp. 1989a.
†Assumes one worker per housing unit.

Worker in-migration and subsequent demand for much of the available housing stock would increase the cost of housing in the study area. The increased housing costs would have the greatest impact on elderly or other fixed-income residents who do not benefit directly from revenues generated from the project. Any actual housing shortage or increases in housing costs probably would increase the need for social services. Overall, the availability of affordable housing is likely to be the single most important factor in determining employee settlement patterns.

Fiscal Effects

The proposed project would generate direct and indirect increases in government revenues. Affected jurisdictions, including Lincoln County, Sanders County, Libby, Troy, Libby School District #4, Troy School District #1, and Noxon School District would receive property tax receipts from one or more of the following sources—

- the assessed value of Noranda's mine/mill facilities;
- the value of the ore produced (gross proceeds taxable valuation); and/or
- the assessed value of new homes and businesses indirectly associated with project development.

The direct taxable value of the mine would increase during construction and reach its peak with full production scheduled for 1996. Total taxable value would then decrease slowly as the value of the mine and mill facility depreciates.

Some increases in local government costs are likely as a result of the mineral development itself. The costs to cities, school districts, and Lincoln County also would increase with each mine-related family that moves into the project area. Costs could take the form of additional capital outlays, personnel costs, and support costs for ongoing programs.

Property taxes. School districts and other local government units in Montana depend heavily on property taxes as their primary local source of revenue. Under normal circumstances, a local government unit may only tax property that is located within its geographic boundaries. Typically each local government unit in which a mine/mill is located would apply its own property tax mill levy to the entire taxable valuation of the mining operation. If the ore body and the mine and mill facilities were in separate taxing jurisdictions, each would tax only that portion of the mining operation located within its jurisdictional boundaries. Furthermore, taxable valuation derived from gross proceeds is normally considered part of the tax base of the jurisdiction where the ore body is located, regardless of where the extracted ore surfaces or is processed.

Montana legislation, however, allows for the "sharing" of tax revenue among local government units when a hard rock mine is designated as a large-scale mineral development. With tax base sharing, each "affected local government unit" may be allocated a portion of the total increase in taxable valuation of the mineral development, regardless of the location of the ore body or facilities. An affected local government unit can be a county, incorporated city or town, or school district.

The provisions of the Hard Rock Mining Impact Act, the Property Tax Base Sharing Act, the Metal Mines Reclamation Act, the Metalliferous Mines License Tax Act, SB 410 and HB 832—

- define what constitutes a large-scale mineral development;
- identify the circumstances under which an Impact Plan would be required;
- identify the circumstances under which local government units would share the taxable valuation of a large-scale mineral development;
- define which local government units are potentially eligible tax base recipients;
- identify criteria for allocating taxable valuation (which determines the actual recipients, as well as the amount allocated to each);
- define what constitutes the property taxable valuation to be shared;
- suggest what might cause tax base sharing to terminate; and
- indicate how the Impact Plan and tax base sharing affect the allocation of the state's metal mines license tax revenues.

Tax base sharing occurs only when an approved Impact Plan identifies a "jurisdictional revenue disparity." As defined in the Tax Base Sharing Act, jurisdictional revenue disparity means on inequitable distribution of property tax revenues resulting from a large-scale hard-rock mineral development determined by the Hard Rock Mining Impact Board in an approved Impact Plan. If tax base sharing is required, each affected local government unit would apply its mill levy to its share of the taxable valuation. Allocation of taxable valuation would be based on the percentage of employees or school-age children residing within each affected local government unit. Tax base sharing also may affect the allocation of the state's annual metal mines license tax revenue designated for counties and school districts affected by mining projects.

The proposed Montanore Project qualifies as a "large-scale mineral development" requiring the development of an Impact Plan. The Impact Plan is intended to identify increased capital, operating and net operating costs to affected local governments resulting from the construction and operation of the mine. Noranda must pay all increased capital and net operating costs. The Impact Plan must be approved prior to Noranda's initiating activities under any operating permit issued by the Department of State

Lands. The Montanore Impact Plan is discussed later in this section.

The ultimate need for local government services and facilities would be affected by many variables, including changes in the timing or magnitude of development, the size or characteristics of the available local workforce, or the number of persons moving into the area as a result of development. The mitigation plan within the Impact Plan is essentially negotiated agreements between Noranda and affected local government units. Projected impacts would be mitigated to a level acceptable to local government officials and school administrators.

Under tax base sharing, if local or in-migrating employees live in communities other than as projected in the Impact Plan, the allocation of taxable valuation and projected revenues would be altered. If actual revenue or expenses differ from projections, "if…then" provisions in the plan would allow for adjustments.

Gross proceeds taxes. The value of minerals mined and processed (called gross proceeds) is one portion of the taxable valuation of a mining operation. Recent Montana legislation (HB 832) reallocates gross proceeds taxes for hard rock mines. The law gives to a county which contains a mineral resources a reserved portion of gross proceeds taxable valuation, regardless of whether impacts are projected to occur in that county. The effect of the law on the development of Montanore is to give Sanders County and the Noxon School District a 20 percent share of the project's gross proceeds taxable valuation. The specific effects of the new law and its relationship with other legislation was clarified during the Montanore Impact Plan review and approval process, discussed in the next section.

The Montanore Hard-Rock Impact Plan. The Montanore Hard-Rock Mining Impact Plan was released by Noranda in December 1990. The Plan determined that the following local government units in the study area would be affected by Montanore development:

- Lincoln County;
- Municipality of Libby;
- Municipality of Troy;
- Libby Elementary School District #4; and
- Libby High School District #4;

The expected revenue disparity for the municipality of Libby triggers the Tax Base Sharing Act between Libby and Lincoln County. The Tax Base Sharing Act would not be invoked for school districts in the area.

According to terms of the Impact Plan, Noranda would satisfy the projected net fiscal deficits to the four affected local government units through property tax prepayments. The proposed total property tax prepayments consist of the following—

- Lincoln County: $204,764 over a 3-year period following commencement of construction; to be used for anticipated need in law enforcement and county administration.
- Municipality of Libby: $23,645 over a 2-year period following commencement of construction; to be used for law enforcement.
- Libby Elementary School District #4: $152,825 over a 1-year period following commencement of construction; to be used for teachers and two relocatable classrooms.
- Libby High School District #4: $18,260 over a 1-year period following commencement of construction; to be used for teachers.

Similar to the projections in this EIS, the projected fiscal impact to each of these local government units within the Impact Plan was dependent upon a number of economic, demographic, and fiscal assumptions that may or may not occur. Deviations from these assumptions would affect not only the projected impacts, but also might cause unforeseen impacts to occur. For this reason, a Montanore Impact Oversight Committee would be established to assist the affected government units in adjusting the terms of the Impact Plan. Noranda has stated it would cooperate with any reasonable request from the Montanore Impact Oversight Committee. As

proposed, the Committee would be comprised of five members representing Lincoln County, the municipality of Libby, the Libby School District, the Troy area, and Noranda. A simple majority vote of the Committee members would constitute a request to Noranda to assist in adjusting the plan by increasing the proposed tax prepayments.

In addition to the tax prepayments and formulation of the Impact Oversight Committee, the proposed mitigation plan includes—

- Security—Noranda would take several actions to protect the public from potential hazards associated with mining operations.
- Fire Protection—Noranda would comply with all state and local fire regulations and provide mobile fire protection on site, including a firefighting vehicle and water tanker.
- Emergency and First Aid Care—A first aid station would be equipped and maintained on site. EMTs would be on staff during all shifts, and a non-licensed ambulance would be available to transport injured persons to the hospital in Libby.
- Wastewater Treatment—A sewage treatment facility would be constructed and maintained on site, and the treated effluent would be discharged into the tailings pond.
- Solid Waste—Inert waste such as concrete would be left in the mine, while other solid waste would be hauled off site to the county landfill.
- Troy Elementary and High School Districts—Noranda has committed to meet with the school districts to discuss Noranda's responsibility for paying additional costs associated with any in-migrating mine students who are handicapped and/or developmentally disabled and who require a special education curriculum.
- Montanore Monitoring Program—Noranda would conduct a quarterly monitoring survey of all employees during the impact period. Information gathered from the monitoring survey would determine whether the number of in-migrants or the settlement pattern of the in-migrants vary from the projections presented in the Impact Plan so that appropriate adjustments in the Plan can be made.

Under provisions of the Hard Rock Mining Impact Act, Sanders County filed an objection to the proposed Montanore Impact Plan in February, 1991. Negotiations over terms of the Impact Plan among Sanders County, Lincoln County and Noranda did not result in a mutual agreement over the proper allocation of taxable valuation and tax revenues. The Hard Rock Mining Impact Board held an informal contested case hearing in July, 1991 to clarify the terms of the disputed Impact Plan. The Board ruled on the Sanders County objection in September, 1991. The Board's order redistributed the taxable valuation of project development to include redistribution of the gross proceeds taxable valuation, and determined an equitable allocation of taxable valuation considering the level of projected impacts, impact costs, and potential tax revenues beyond impact costs for each affected jurisdiction. Table 4-49 summarizes the effects of the Board's order on potential taxable valuation and revenues for Lincoln County, the City of Libby, and Sanders County. Table 4-50 shows potential fiscal effects on the Libby and Noxon School Districts.

Severance taxes. Montana imposes two severance taxes on hard rock mines. Each is based upon the gross value of the mineral produced. A resource indemnity trust tax rate of 0.5 percent is levied against gross value in excess of $5,000. A metal mines license tax is levied against gross value in excess of $250,000. The metal mines license tax rate is either 1.81 percent of the value of a concentrate shipped to a smelter, mill or reduction work, or 1.6 percent of any gold, silver, or platinum group metal shipped to a refinery. Assuming copper at $1.00 per pound and silver at $5.50 per ounce, annual metal mines license tax payments by Noranda would be about $2.8 million at peak production.

Table 4-49. Estimated fiscal effects of project development (at full production).

	Lincoln County	City of Libby	Sanders County
Taxable valuation allocation	$6,033,643	$1,333,500	$3,696,357
x Mill Levy	x .04197	x.06610	x.06534
Tax Revenue	$253,232	$88,134	$241,519
Identified Impact Cost	$85,000	$20,000	$-0-
+ Annual Tax Credit	+ 39,000	+ 5,000	+-0-
Annual Impact Costs	$124,000	$25,000	$-0-
Mineral Dev. Revenue	$253,232	$88,134	$241,519
-Annual Impact Cost	- 124,000	- 25,000	- -0-
Margin or Windfall	$129,232	$63,134	$241,519

Source: Montana Hard Rock Impact Board, Minutes from Conference Call, 9-10-91

Twenty-five percent of the Montana metal mines license tax revenue is allocated to the county in which the mine is located and through the county to the affected school districts. The county must reserve at least 40 percent of this revenue in a trust reserve account, which can be expended only following a 50 percent reduction in the mine's workforce or following the mine's closure. Fifty-eight percent of the metal mines license tax revenue is allocated to the Montana general fund.

Table 4-50. Estimated direct property tax revenue received by affected school jurisdictions (at full production).

Jurisdiction	Property tax revenues ($000s)
Libby high school and elementary school districts	747.9
Lincoln County County-wide	792.6
Noxon high school and elementary school districts	19.8
Sanders County County-wide	70.0

Source: IMS Inc.

Hard rock mines that pay metal mines license taxes are not required to pay the resource indemnity trust tax. Instead, 15.5 percent of the State's metal mines license tax revenue is allocated to the Resource Indemnity Trust Fund. Interest from the RIT Fund is used to protect and restore the environment from impacts resulting from mineral development. To compensate residents for the depletion of the State's mineral resource base, RIT interest is also used to provide other benefits, including development of the State's water resources.

Social Well-being and Quality of Life

The Montanore Project would have relatively minor effects on social well-being and quality of life in the project area. Mining and other natural resource development has been an important part of the local economy for many years. Integration of newcomers should occur relatively easily. Individuals and social groups within the community would perceive project-related benefits, such as increased economic opportunity, and costs such as social problems associated with population growth, from the perspective of their own values, beliefs and goals. Such perceptions would of course vary. Increased

income within the project area would create new opportunities in the retail sales and service sector. Some residents believe the proposed project would revitalize and stabilize the depressed local economy.

Negative perceptions of project development may be attributed to people with various other points of view. Many residents express anxiety at the prospect of a major mineral development project, based on their experience with and perceptions of other mining projects. These concerns primarily are that the Montanore Project might generate similar problems, and that State and Federal agencies might not adequately monitor and enforce applicable laws and regulations. Persons having these views want their feelings known, but are not necessarily opposed to development of the Montanore Project.

Assumption Sensitivity Analysis

The results of the employment, population, and income analysis described in the previous sections (termed the base case analysis in this discussion) are dependent upon a number of assumptions. If assumptions used in the analysis do not occur, the effects of Montanore Project would be different than those projected in the base case analysis. To show how assumptions affect the estimates of employment, population in-migration, and income, an alternative case was developed.

This alternative case consists of changes in the assumptions used in two important areas—the local (existing resident) hiring rate, and the indirect employment effects from the new project-related jobs. While the base case projection of 80 percent local hiring for operations workers is reasonable given current information, there are many external factors which could lessen the actual local hiring rate. There is also some uncertainty as to the proper indirect employment multipliers. A major new project has not occurred in Lincoln County since the Troy Mine was developed in 1979, so there is little recent empirical data on which to base a multiplier. Indirect employment multipliers which are higher than those used in the base case analysis have been observed in other areas, and a 1982 study of Troy Mine economic impacts projected a Lincoln County multiplier of 0.8955 indirect workers for each new mining job. (ASARCO, Inc. and TAP, Inc., 1982).

The three specific assumption changes in the alternative case analysis include—

- the local (existing resident) hiring rate for operations workers is reduced from 80 percent in the base case to 50 percent in the alternative case;
- the indirect employment effects of basic Montanore construction employment is increased from 0.3 indirect workers per new construction job to 0.6 indirect workers per job; and
- the indirect employment effects of basic Montanore operations employment is increased from 0.45 indirect workers per new construction job to 0.9 indirect workers per job.

Consideration of alternative multipliers will help account for the uncertainty of the proper Lincoln County multipliers. All other assumptions and data used in the base case are used in this alternative case analysis.

Population effects of the analysis are presented in Table 4-51 (for Lincoln County as a whole) and Table 4-52 (for distributional effects in Libby, Troy, and rural Lincoln County). With these changes in assumptions, the peak Lincoln County cumulative population increase in 1995 due to Montanore development would be 854 persons compared to 411 persons in the base case. Other alternative case results and comparisons to the base case analysis include—

- long-term Lincoln County population cumulative in-migration is estimated at 779 persons compared to 319 in the base case;
- peak cumulative indirect employment is estimated at 425 persons in 1996, compared to 210 in the base case;
- long-term cumulative indirect employment is estimated at 400 persons, compared to 200 in the base case;

Table 4-51. Cumulative Montanore Project employment and population in-migration effects in Lincoln County–*Alternative case*.

Project year	1	2	3	4	5
Calendar year	1993	1994	1995	1996	1997
Project employment					
Construction	170	190	90	0	0
Operations	30	130	440	450	450
In-migrating population					
Construction employees	94	105	50	0	0
Operations employees	15	65	220	225	225
Indirect employees	6	18	34	43	41
Spouses	72	126	226	206	204
Children					
K–8	31	65	147	141	141
9–12	13	28	62	60	59
Not in school	24	51	115	110	109
Total	255	458	854	785	779

Source: IMS Inc. and Noranda Minerals Corp. 1989a.

- peak housing needs in Lincoln County are estimated at 304 units in 1995, compared to 155 units needed in the base case;
- long-term cumulative housing needs in the county are estimated at 266 units, compared to 110 in the base case;
- cumulative children in-migrating into the county are estimated at 324 children, compared to 146 children in the base case; and
- the estimated annual income (direct and indirect employees) resulting from Montanore Project development is estimated at $15.64 million, compared to $13.82 million in the base case.

From these comparisons, the importance of local hiring and indirect project effects can clearly be seen. Monitoring of employment, population, and income data would be necessary to determine the actual magnitude and duration of impacts.

Temporary or Permanent Closure

During construction and operation periods, the Montanore Project would provide a significant

Table 4-52. Peak cumulative in-migration—Libby, Troy, and other Lincoln County areas—*Alternative case*.

	Libby					Troy					Other Lincoln County areas				
Project year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Calendar year	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997
Construction employees	42	47	22	0	0	5	5	2	0	0	47	52	25	0	0
Operations employees	2	10	33	34	34	1	3	11	11	11	12	52	176	180	180
Indirect employees	2	6	8	7	6	0	1	2	2	2	4	11	25	33	32
Spouses	29	40	44	31	31	4	6	11	10	10	40	80	170	164	163
Children															
K–8	11	18	26	21	21	2	3	7	7	7	18	45	114	113	113
9–12	5	7	11	9	9	1	1	3	3	3	8	19	48	48	48
Not in school	9	14	20	17	16	1	3	6	5	5	14	35	89	88	88
Total	100	142	164	119	117		22	42	38	38	143	294	647	626	624

Source: IMS Inc., 1990.

source of employment, income, and tax revenue. If the project were to close prematurely, employees would lose their jobs, thereby increasing unemployment and decreasing personal and governmental income. Actual effects would depend on the length of closure and unemployment benefits available to unemployed workers.

If operations proceed as currently planned, mining and milling activities at the Montanore Project would cease in 2011. When the mine is closed, the local area economy would lose 450 high-paying jobs. To help mitigate the fiscal and economic impacts resulting from mine workforce reduction and mine closure, the Hard Rock Impact Act (as amended by SB 410 in 1989) establishes a Hard Rock Mining Impact Trust Account. SB 410 provides counties and school districts with revenues that are to be held in trust to address both economic and fiscal impacts resulting from mine closure or from a major workforce reduction.

ALTERNATIVE 2 AND 3

Noranda would develop written policies concerning local hiring and develop a worker training program. These policies and training program would seek to maximize local hiring, with the goal of obtaining at least 80 percent local hiring rate for operations workers, and 50 percent local hiring rate for construction workers. This would ensure a minimal number of new people moving to the area.

ALTERNATIVES 4, 5 AND 6

Selection of an alternate transmission line route would not change the overall socioeconomic effects discussed under Alternative 1.

CUMULATIVE IMPACTS

Beside the proposed Montanore Project, ASARCO's existing Troy Mine and the proposed Rock Creek Project affect the Lincoln and Sanders Counties' present and future socioeconomic environment. Other mineral activities in the area—primarily small exploration projects—are not expected to lead to major development in the reasonably foreseeable future. Issues and concerns regarding the role of the regional timber industry in the cumulative environment also are discussed later in this section.

Mining activities. The Troy Mine in Lincoln County employs approximately 350 people with an annual payroll of $11.4 million. The Troy Mine may close as early as 1995 unless additional ore reserves are proven near existing facilities. An estimated 88 percent of the employees at the Troy Mine live in Lincoln County, 8 percent live in Sanders County, and 4 percent live in Idaho.

Another potential mine is located near Rock Creek, a few miles northwest of the proposed Montanore Project. ASARCO submitted an application to acquire an operating permit for the Rock Creek Project in May, 1987. The nearest town to the proposed Rock Creek development is Noxon, an unincorporated town on State Highway 200 in Sanders County. Access to the Rock Creek mine would be from the Noxon area, and mine facilities also would be located in Sanders County. ASARCO estimates full production employment of 350 people, with an estimated annual payroll of $12 million. Based on permitting time frames and ASARCO's projected three-year construction period, the earliest the Rock Creek mine could go into production is late 1996. Mine life of the Rock Creek operation is estimated to be 30 years, nearly twice that of the proposed Montanore Project.

Total peak construction employment demand for the Rock Creek project would be 345 workers. It is estimated that about 30 employees, or 16 percent of the total in-migrating construction workforce for the Rock Creek mine would reside in Lincoln County. Including family dependents, this would amount to a total of about 63 people. Total peak operations employment demand for the Rock Creek project would be 350 employees. Of the in-migrating workforce, about 8 percent, or six employees, would reside in Lincoln County. The total peak population

increase in Lincoln County from the Rock Creek project during operations is estimated to be about 20 people.

The peak population increase associated with Rock Creek development in Sanders County is projected to be about 330 people during project construction. The projected long-term population increase in Sanders County attributable to the Rock Creek Project is estimated to be about 200 people. The vast majority of both positive and negative effects from Rock Creek development would occur in Sanders County.

A key factor determining the number of in-migrating workers for both the ASARCO Rock Creek Project and the Montanore Project is the fate of the ASARCO Troy Mine. Upon closure of the Troy Mine, a skilled workforce of 350 may be available either to the Rock Creek or Montanore project. Since the Montanore Project production start-up is expected in 1995, assuming approval of the operation, and Rock Creek operation may not begin until 1996 or later assuming approval, there would not necessarily be any major direct competition for former Troy workers.

However, since much of the Troy Mine workforce already lives in the Libby area (about 33 percent of total Troy Mine employment), some of these workers would be expected to seek employment with Noranda at Montanore to avoid the longer commuting distance to the Rock Creek Project. Assuming Troy Mine closure and Rock Creek Project startup are relatively concurrent, many current Troy Mine workers would continue employment with ASARCO for the Rock Creek operation because of employee seniority and benefit vesting in ASARCO.

With the availability of the Troy Mine workforce for one or both of the new projects and current unemployment rates in Lincoln and Sanders counties, 80 percent local hiring for both projects would be still possible. If only one of the two projects is developed as planned (either Rock Creek or Montanore, but not both), the displaced Troy Mine workforce may provide a substantial amount of the needed workforce. If Rock Creek is developed, but the Montanore Project is not, some Lincoln County residents currently working at the Troy Mine may migrate to Sanders County to shorten their commute.

If the Troy Mine (with additional reserves extending the mine life), Rock Creek, and Montanore were all to operate concurrently—which is considered unlikely based on available current information—the Troy Mine workforce would not be available to the two new projects, and the 80 percent local hiring assumption might not be met. This scenario would result in a larger population migration into Sanders and Lincoln counties than would result from the development of only one project. It also would result in the greatest level of community disruption.

Under the most likely situation, no in-migrating workers directly associated with the proposed Montanore Project are expected to reside in Sanders County. From a standpoint of cumulative impacts, therefore, the Montanore Project is not expected to have any direct effect on employment, population, or public services in Sanders County. Table 4-53 shows the relationship of future socioeconomic environments with projected population increases due to operation of both the Rock Creek and Montanore projects in Lincoln and Sanders counties.

Timber activities. As discussed in Chapter 3, the timber industry plays a major role in the regional socioeconomic environment. This industry has traditionally been the major employer and wage-provider in Northwest Montana. The future of the timber industry is a major issue affecting the cumulative Lincoln County environment.

According to Keegan et al. (1990), 53 percent of timber processed in Lincoln County in 1988 came from private lands. USFS lands supplied 46 percent of timber with State of Montana lands supplying 1 percent. Therefore, the health of the timber industry

in Lincoln County has been approximately equally dependent upon private and Federal timber.

In the past several years, the timber market in the entire Northwestern United States has been negatively affected by decreasing demand for timber (e.g., a severe slump in the U.S. housing industry and increased recycling of paper products) and environmental protection pressures (e.g., protection of the grizzly bear and spotted owl). Employment has also been affected by such factors as increased mechanization and structural changes in the timber production and processing industry. The recent Champion layoff and other symptoms of a timber industry decline in Lincoln County are reflective of regional changes and cycles.

There are several indicators which show how the industry decline has affected Lincoln County. First, the 1990 U.S. Census figures show a population decline occurred in Lincoln County during the late 1980s and into 1990. Second, 1991 data from the State of Montana Department of Labor and Industry show a major increase in Lincoln County unemployment over the same months in 1990. The number of persons in the labor force and the number of people employed in Lincoln County also decreased in 1991 compared to 1990. There was a year-long downward trend in pupil enrollment in the Libby schools during the 1990-91 school year, indicating a possible out-migration of working parents and their children during this period. Finally, data on the KNF timber management and sales program indicate consistent declines over the FY87 through FY90 period in timber industry jobs associated with the KNF program, value of KNF timber activities to communities, KNF timber offered for sale, KNF timber sold, and the volume of KNF timber harvested (see Table 4-54).

Table 4-53. Cumulative population impacts.

Year	Projected baseline population	Projected population growth		Total
		Rock Creek Project	Montanore Project	
Lincoln County				
1990	17,481	0	25	17,506
1995	17,555	20	411	17,986
1996	17,574	30	322	17,926
2000	17,769	20	319	18,108
2005	18,021	20	319	18,360
2010	18,282	20	319	18,621
Sanders County				
1990	8,669	0	0	8,669
1995	8,998	80	0	9,078
1996	9,080	250	0	9,330
2000	9,377	200	0	9,577
2005	9,626	200	0	9,826
2010	9,922	200	0	10,122

Source: IMS Inc. 1992.

Table 4-54. KNF timber program indicators—FY 1987 through FY 1990.

Indicator	FY87	FY88	FY89	FY90
Total Jobs	2,630	2,650	2,450	2,310
Value to Communities ($)	112,136	84,288	76,690	74,690
Timber Offered for Sale (million board feet)	240.0	188.7	188.0	151.4
Timber Sold (million board feet)	239.9	178.6	187.4	150.4
Volume Harvested (million board feet)	248.3	248.1	224.5	212.2

Source: Timber Sale Program Information Reports, KNF, 1989 and 1990.

Overall, these data indicate a slump in the Lincoln County timber industry, resulting in a decreased population and higher unemployment. The increasing unemployment and displacement of the local population have certainly led to increased uncertainty about the future, affected existing social systems and structures, and increased demand for social services.

However, it should be remembered that the timber industry is highly cyclic in nature. For example, Lincoln County led the state in production in 1976, 1981, and 1988, with 1988 being the highest production year (Table 4-55). Sanders County production in 1981 and 1988 declined significantly from 1976 levels. Mills in Lincoln County received about 99 percent of their timber from within the county in 1976 and 1981, compared to 79 percent in 1988. These and other data in Keegan et al. (1990) show the variability and contrasts for Montana's forest products industry over the 1970s and 1980s.

It cannot be stated with any degree of certainty whether the timber industry trends exhibited in the late 1980s will continue or not.

The interaction between the timber industry and mining development in the cumulative Lincoln County socioeconomic environment is an important economic issue for the 1990s and beyond. There are indications that mining employment and other benefits of development could compensate for timber industry declines if these declines continue into the mid-1990s and beyond. Under Alternative 7, economic decline would continue.

RESOURCE COMMITMENTS

Under the action alternatives, the project would alter the social and economic life of Libby and Lincoln County. Increased demand for housing and some social services would be an irretrievable commitment of resources.

Table 4-55. Timber products harvested—1976, 1981 and 1988.

	1976		1981		1988	
	Million Board Feet (Scribner)	Percent of State Total	Million Board Feet (Scribner)	Percent of State Total	Million Board Feet (Scribner)	Percent of State Total
Lincoln County	293	25.3%	267	25.8%	324	26.2%
Sanders County	153	13.2%	93	9.0%	89	7.2%
State Total	1,160	100.0%	1,035	100.0%	1,236	100.0%

Source: Timber Industry Surveys, University of Montana, 1976,1981, and 1988.

ALTERNATIVE 7

Without the Montanore Project, economic benefits in both the private and public sectors would not be realized. New or existing residents would lose the economic development benefits from 450 jobs during operations, 190 jobs during construction, and $13.82 million in annual income associated with long-term operations. These benefits are especially important given the potential shutdown of Troy Mine operations in the mid-1990s.

The long-term population increase of 320 people would not occur and the requisite community services and housing would not be needed. Population growth in Lincoln County would continue according to baseline projections shown in the Population and Demographics section under Socioeconomics in Chapter 3. Social conflict between those favoring the project and those opposed would gradually end. Persons who place a higher priority on environmental preservation and no population increases would perceive benefits resulting from the no action alternative.

CULTURAL RESOURCES

SUMMARY

Under Alternative 1, the proposed project would destroy historic site 24LN942, a collapsed log cabin, trail, two-track road and depression. Site 24LN942 is not eligible for nomination to the National Register of Historic Places and direct impacts to this site would not be considered adverse. No known prehistoric or Native American resources would be adversely affected by the project. No additional mitigation measures would be necessary for cultural resources in the mine and impoundment areas. Pedestrian surveys along the transmission line route, access roads, and substation site would be required.

Based on existing information, impacts under Alternatives 2, 3, and 4 would be the same as Alternative 1. Impacts of Alternatives 5 or 6 would be less than Alternatives 1 or 4. Cultural resources survey of the final location for the transmission line and related access roads and clearance by the agencies would be required prior to line construction. Site 24LN942 would not be affected under Alternative 7.

ALTERNATIVES 1, 2, AND 3

Types of Impacts

An accepted classification of impacts to non-renewable cultural resources (Prehistoric, Historic and Native American) considers both direct and indirect impacts. Direct impacts are primarily the effects related to project construction, operation and maintenance. Indirect impacts are usually attributable to things such as better access and increased traffic to previously isolated sites, thus increasing the potential for vandalism. Direct and indirect impacts are classified as follows—

- no measurable direct or indirect impact;
- no adverse impact—measurable impacts which do not adversely affect a site's physical integrity or other criteria which would qualify a site for listing on the National Register of Historic Places (NRHP); or measurable impacts to a site not eligible for the NRHP; and
- adverse impact—measurable impacts which adversely affect the physical integrity or other NRHP qualifying criteria of the resource. Specifically, a site is adversely affected when its

location, design, setting, materials, workmanship, "feeling," association or other characteristics which may qualify it as significant according to the National Register criteria, are changed. If a recorded cultural resource meets eligibility requirements for nomination to the NRHP, it is necessary to apply Criteria of Effect (36 CFR 800) to determine effects of the proposed project.

Affected Sites

Noranda's proposed project would destroy site 24LN942, including a collapsed log cabin, trail, two-track road, and depression. This site is not eligible for nomination to the National Register of Historic Places. Direct impacts to this site would not be considered adverse. Known prehistoric or Native American resources could be avoided through location adjustments of the substation, transmission line and access roads to avoid potentially adverse effects

ALTERNATIVES 4, 5 AND 6

Noranda reviewed the existing cultural database and performed additional reconnaissance level inventory along the alternative centerlines. Table 4-56 lists the known resources affected by the alternatives. Impacts to most sites listed in Table 4-56 would result from visual intrusion of the proposed facilities.

Table 4-56. Known historical and archaeological sites affected by the transmission line alternatives.

Site No.	Site type or Name	National Register status	Affected by	Action necessary if alternative is selected§
24LN311	Barren Peak Lookout	Eligible	Microwave site	
24LN962	Teeters Peak Trail	Recommended ineligible	Alternative 4	Resolve eligibility
24LN963	Standard Creek to Howard Creek Trail	Recommended ineligible	Alternative 4	Resolve eligibility
24LN976	House	Ineligible	Alternatives 4, 5, and 6	
24LN977	Manicke School-Church	Eligible	Sedlak Park substation	
24LN980	Placer mine and and ditch along Howard Creek	Recommended ineligible	Alternative 4	Resolve eligibility
MW-89-SL6	Libby-Neils railroad	Undetermined†	Alternative 6	Formally record and resolve eligibility
FS #146	Midas Mine	Undetermined†	Alternative 4	Formally record and resolve eligibility
Locus 2	Scarred trees	Undetermined†	Alternatives 4, 5, and 6	Formally record and resolve eligibility

Source: Department of Natural Resources and Conservation. 1991.
†The eligibility of sites marked as "undetermined" must be resolved prior to mitigation being developed and decision by KNF.
§A determination of effect would be completed for any affected site determined eligible.

Additional site-specific survey of individual pole and access road locations and other areas such as pulling sites and storage yards would be performed to complete an evaluation of historical and archaeological impacts along the selected alternative. This survey is required under procedures KNF and Noranda must follow to comply with the National Historic Preservation Act. Areas with high probability of new site discovery have been identified for each of the alternatives as shown on Figure H-1 in Appendix H.

Noranda would conduct on-the-ground inventory and assessment work on the selected alternative prior to final tower and access road design. Areas where additional work would be needed include crossings of the Fisher River and other streams, and along ridge tops crossed by each of the alternatives. Flexibility would be maintained by KNF and Noranda to change proposed location of poles and access roads within the 500-foot wide strip to avoid significant sites discovered during additional field surveys. At historic sites that could not be avoided, Noranda would be required to mitigate in accordance with recommendations from the Montana State Historic Preservation Office (SHPO) and the National Advisory Council on Historic Preservation. The Kootenai Tribes will be consulted on the prehistoric sites in compliance with the American Indian Religious Freedom Act.

CUMULATIVE IMPACTS

Cumulative impacts to cultural resources from the proposed Montanore Project could include the possibility of increased vandalism resulting from improved access to known, recorded historic resources. Cumulative impacts from other reasonably foreseeable developments, such as ASARCO's proposed Rock Creek mine, U.S. 2 road reconstruction, timber sales and other mineral activity are unknown because cultural resources in these areas have not been identified.

RESOURCE COMMITMENTS

The proposed project would irreversibly destroy one cultural resource. The resource that would be destroyed, however, is not unique and does not warrant inclusion into the National Register of Historic Places.

ALTERNATIVE 7

Historic sites in the project area would not be affected.

NOISE, ELECTRICAL FIELDS, RADIO AND TV EFFECTS

SUMMARY

Selection of Alternative 1 would result in noise impacts from stationary and non-stationary noise sources during mine development and operation. Stationary equipment such as crushers, ventilation fans and generators, and non-stationary equipment such as dozers, rock trucks and loaders, have a 7,000-foot zone of audibility feet under worst case conditions. Taking the effects of surface absorption and topography into consideration, the zone of audibility would be reduced to less than one mile. Vehicles traveling from the Ramsey Creek plant site along the Bear Creek Road and U.S. 2 to Libby would increase noise levels along these corridors.

Mitigation measures associated with Alternatives 2 and 3 would minimize noise impacts from construction activities. There would be no difference in effects between transmission line Alternatives 4, 5 or 6 and Alternative 1. Alternative 7 would result in no noise impacts.

ALTERNATIVE 1

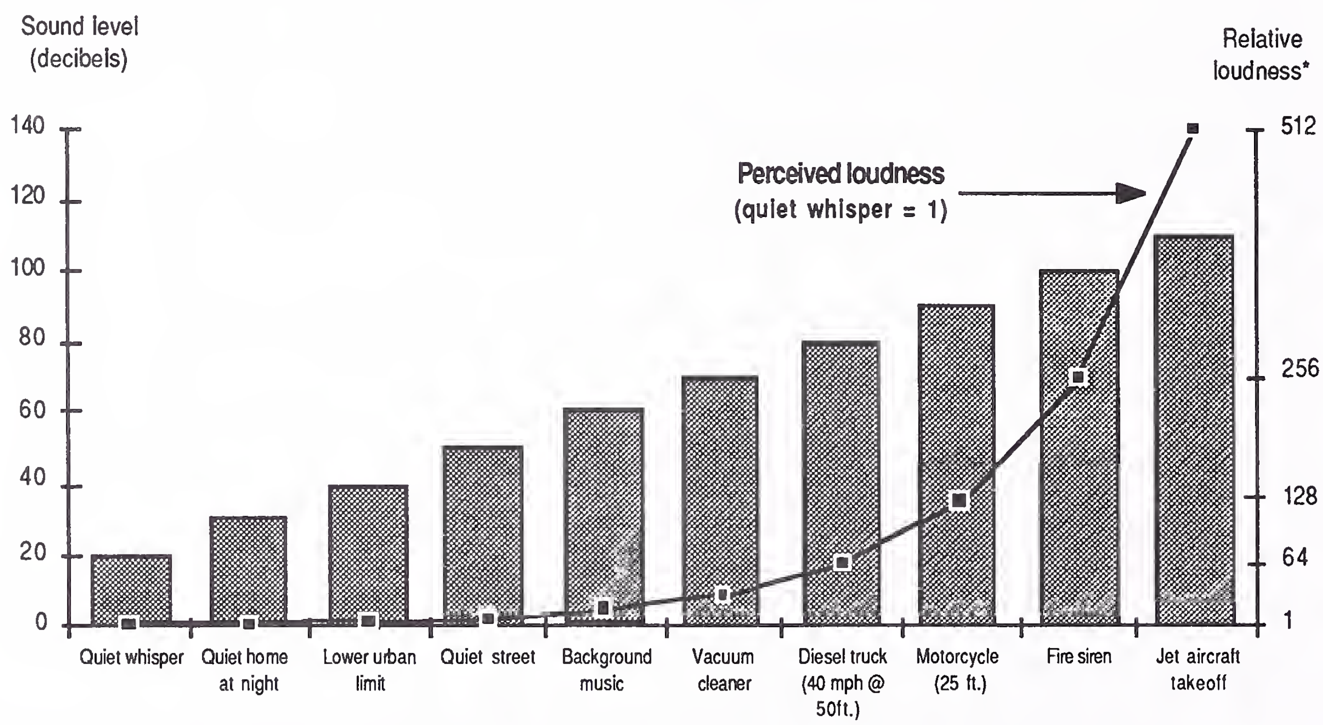
Noise Sources and Effects

Ambient noise. Noranda's proposal would increase the ambient noise levels in the area around the plant site and portals. Noise levels also would increase along the haul route. Existing minimum ambient noise levels at the Ramsey Creek site and at the Cherry Creek site range from levels as low as 22 dB(A) in the nighttime to 35 dB(A) during the daytime. Occurrences of higher natural ambient noise levels are caused by such things as wind, rustling foliage, insects, birds and other wildlife, thunder, and rain. Levels of typical noise sources and their relative loudness are shown in Figure 4-9.

Construction and operations noise. Highest noise levels would be generated at the plant site, with maximum sound levels reaching up to 125 dB(A) at 900 feet for short periods as a result of blasting. Blasting noise would be greatest during initial adit construction; as the adits go deeper, blasting noise would decrease. Other sources of sound at the plant site would include trucks, bulldozers and other equipment or vehicles during construction and operations. Typical noise levels from construction equipment range from 110 to 120 dB(A) at 50 feet. Equipment used during operations would generate less noise, ranging from 80 to 90 dB(A).

During mine development ,the ventilation fans would be located at the surface. The sound power level for mine ventilation fans is about 123 dB(A) and would result in a sound pressure level of 48 dB at one mile from the portal when there is no intervening

Figure 4-9. Perceived loudness relative to measured noise levels.



*Perceived loudness doubles with every 10 dB increase in sound level. A quiet whisper [20 dB(A)] is arbitrarily assigned a relative loudness value of 1.

Source: IMS Inc. 1990.

topography. When construction is completed, the fans would be located near the ore body which would be at a distance of about 15,000 feet from the portal. Sound would be reduced in mine adits about 0.3 dB per 100 feet; for a 15,000 foot adit the reduction would be 45 dB. The resulting sound pressure level at the portal would be about 70 dB(A) or equivalent to a sound power level of 78 dB(A) which would result in a sound pressure level of 30 dB(A) at 400 feet from the portal and inaudibility at a distance of 1 mile.

Noise at the tailings impoundment and land application disposal area would be generated by heavy equipment during construction and by occasional vehicular traffic, pumps and associated equipment, and bulldozers during operations. The sound from bulldozers would be periodic.

Because the ambient sound levels throughout the mine area are low, the zone of audibility associated with the mining operation would extend about one mile around each project facility. Haul trucks with inadequate mufflers may be audible up to two miles.

Transmission line construction noise. Transmission line construction would temporarily increase daytime ambient noise levels along the transmission line corridor. During the estimated four-month transmission line construction period, construction equipment such as bulldozers, loaders, and haul trucks would generate 100 to 120 dB(A) at 50 feet. Chain saws and logging trucks used in forest clearing for the line would generate similar noise levels (Noranda Minerals Corp., 1989a). These sounds would generally occur in hilly, forested areas, which serve to reduce sound audibility. If a helicopter is used for line stringing, its noise would be widely audible for an estimated one-week period.

Because of generally low ambient background noise levels, the transmission line clearing, road construction, and line construction activities would be generally audible for approximately one mile. Equipment trucks or logging trucks with inadequate mufflers or Jake brakes could extend the audible area. All off-site truck traffic would temporarily increase noise levels at residences adjacent to travel routes to and from the construction area. The effects would be similar to logging trucks transporting logs from an active timber sale area.

Transmission line noise. The proposed 230-kV electrical power transmission line would produce soft hissing and crackling sounds in wet weather. In fair weather, these noises are virtually inaudible. During the light rains or wet snows which occur about 10 percent of the time in the project area, the Montanore Project transmission line would produce a noise level of about 43 dB(A) at the edge of the right-of-way (Noranda Minerals Corp., 1989c). This sound level is slightly above naturally occurring levels and would be only faintly discernable. During operation, noise from the substation would be faintly discernable beyond the fenced site.

Transportation noise. Haul trucks operating on the access roads would produce sound levels of 86 dB(A) at 50 feet for trucks with properly maintained mufflers. Trucks using Jake brakes with straight pipe mufflers would produce sound levels of 98 dB(A) at 50 feet, and would be audible at distances of up to, but generally not exceeding, one mile. These haul trucks would affect residences adjacent to the haul route. The impact would be the most at night.

Cabinet Mountains Wilderness. Sound generated at the plant site would be audible inside the Cabinet Mountains Wilderness. The wilderness boundary is about 0.5 mile west and about 0.75 miles north and south of the proposed plant site. The ridge that surrounds the plant site, all of which is within the wilderness, ranges in elevation from 6,400 feet on the north to over 7,900 feet (Elephant Peak) on the west. Equipment with sound levels of 115 dB(A) would be audible at locations within one mile of the plant. The ridges to the north and south of the plant site are difficult to reach and probably have little human occupancy. The ridge to the west is two miles away and about 3,000 feet higher than the plant site. Elephant Peak, a destination peak for mountain

climbers, is on this ridge. Most mining-related noise would not be audible on Elephant Peak. During initial adit construction, occasional blasting noise might be audible.

Electric and Magnetic Fields

The Montanore Project transmission line would generate electric and magnetic fields. These fields pose no known risk to vegetation, livestock, or wildlife. They may, however, induce a current in ungrounded metal objects such as fences crossed by the right-of-way. A person touching an ungrounded object might receive a mild shock, much like that received when touching a metal doorknob after crossing a carpet. Noranda would ground all metal fences or structures crossed by the transmission line to minimize nuisance shocks.

Under a maximum load of 125 amps, the proposed 230-kV transmission line would produce an electric field strength at the edge of the right-of-way of about 0.75 kilovolt per square meter (below the Montana standard of 1.0 kV/m).

The line would produce a magnetic field strength of about 5 milligauss at the edge of the right-of-way (Noranda Minerals Corp., 1989c). Although these field strengths are no greater than those produced by household appliances, there is clear evidence that the fields themselves can produce subtle hormonal and chemical changes in living organisms. It is not yet clear if these changes constitute a risk to public health.

Extensive research has been conducted on the human health implications of electromagnetic fields, and many more studies are underway. The results so far are complex and ambiguous. The scientific community does not yet agree on whether the fields pose a risk to human health and, if they do, how serious that risk might be. Continuing research should help reduce some of the present uncertainty (Morgan, 1989). Most risk studies have focused on the chronic, long-term exposure to electromagnetic fields experienced by people living next to lines. The proposed transmission line would be located at least 500 feet from existing residences, far enough away that these fields would not be a factor. Most human exposure would be short-term and occur as highway travelers or forest users pass under or near the facility. This brief exposure is not expected to have any effect on people's health.

Electric fields at the substation sites would be dominated by the fields created by the transmission lines passing through the substation. Exposure to these fields is expected to be short-term and would not be likely to have any adverse effects on the public's health.

Radio and TV Interference

The transmission line would generate radio noise which may interfere with AM radio and television reception close to the line. FM broadcasts and 2-way communications are generally not affected. Depending on the line's final engineering design, radio-generated noise levels would be between 40 and 65 decibels at the edge of the right-of-way. The effect of the line on AM radio and TV interference decreases rapidly as distance from the line increases. At any residence which more than 600 feet from the location of line, radio and TV interference is not expected to be a problem. TV interference is only likely to occur if the line is within 500 feet of a residence and the conductor is in the path of the TV signal. If interference does occur once the line is energized, Noranda or the operating utility would correct this as required by Federal Communication Commission regulations. Correction of the problem would depend on site specific circumstances but measures such as installation of remote antennae could correct most problems. According to FCC regulations, the line must not degrade radio or TV reception beyond current levels. Possible radio and TV interference problems along the transmission line normally cannot be accurately identified until the final line location and design are known.

ALTERNATIVES 2 AND 3

Noranda would ensure all equipment has properly maintained mufflers and other noise control equipment. Noise levels associated with equipment would be less than the EPA standard. This measure would ensure acceptable noise levels at the project facilities and along the access road.

Where possible, backup beepers would be replaced with the strobe light-type warning devices and the sound level of the backup beepers would be reduced to less than the normal 110 dB(A) at 10 feet. Regulations stipulate that the sound level of backup beepers must be audible in affected work areas. Sound levels of 90 to 100 dB(A) at 10 feet would provide audible warning at distances up to 50 feet behind a large front end loader.

ALTERNATIVES 4, 5 AND 6

There would be no difference in noise, electric and magnetic fields, and radio and television interference between the proposed transmission corridors and the other alternatives.

CUMULATIVE IMPACTS

Traffic noise at various distances was estimated using a computer simulation technique, and monitored and projected traffic levels on the Bear Creek Road and U.S. 2 (Table 4-57). Estimates were conducted for baseline mine related traffic, and for baseline, mine and logging traffic. Cumulative noise levels would be increased about 20 decibels on the Bear Creek Road and 15 decibels on U.S. 2 over baseline conditions.

ASARCO's proposed Rock Creek project would not be close enough to the proposed Montanore Project to cause a cumulative noise impact. Because these projects use different access and haul routes, transportation noise associated with these projects would not be cumulative.

RESOURCE COMMITMENTS

During construction and operation of the mine, sound levels would be higher throughout the project area and in the Cabinet Mountains Wilderness than at present. Following mine closure, sound levels

Table 4-57. Equivalent noise levels on Bear Creek Road and U.S. 2 with and without mining and logging impacts.†

Distance from roadway (ft.)	Traffic baseline	Baseline + mining	Baseline + mining + logging
	L_{eq} in dB(A)		
Bear Creek Road			
50	60.1	67.4	78.5
200	50.5	57.9	69.8
800	40.7	48.0	59.9
3,200	28.0	35.2	47.2
U.S. 2			
50	64.6	71.3	78.4
200	55.1	61.8	69.6
800	45.3	51.9	59.7
3,200	32.6	39.1	47.0

Source: IMS Inc., using Fed. Hwy. Adm. STAMINA 2.0/Optima program.
†Assumed maximum vehicle speed on Bear Creek Road is 35 mph; on U.S. 2, 55 mph for cars, 45 mph for trucks.

would return to pre-mine levels. There would be no long-term irreversible or irretrievable commitment of resources.

ALTERNATIVE 7

Alternative 7 would result in no noise impacts.

TRANSMISSION LINE NEED, COST AND RELIABILITY

SUMMARY

The mine would not be able to operate without a power supply. A 230-kV transmission line connecting the mine to the existing Noxon-Libby 230-kV line would supply the mine at the lowest cost.

The power line is estimated to cost $3.1 million to $3.3 million to build. Noranda's annual power cost would be approximately $9.3 million. Of the alternatives analyzed in detail, Alternative 5 would be slightly cheaper, while Alternative 1 would have fewer poles at high altitudes.

ALL TRANSMISSION LINE ALTERNATIVES

Need

There is no transmission line to the site. Without the proposed line or one of the alternative lines, the mine could not operate. On-site generation for full operation of the mine was determined to be not feasible due to construction and operating costs as well as greater environmental effects. The mine could operate with a 115-kV line rather than the proposed 230-kV line. A lower voltage line, however, would cost more to build and operate. A lower voltage line to the mine would require an additional transformer to change the voltage and also would have higher line losses, four times higher than a 230-kV line. A 230-kV voltage line appears to be the most cost effective for the proposed mine loads.

If all electrical equipment at the mine site were operated at once, the load would be 50 MW. However, Noranda expects the actual peak load to be 40 MW. The annual energy use at the mine is expected to be 274 million kilowatt-hours. Noranda's annual electricity cost would be approximately $9.3 million.

If the mine is profitable over its lifetime, the benefits of the transmission line almost certainly exceed the costs. If the mine is not profitable and is not operated as planned, the benefits might not be greater than the costs. In either case, the benefits and costs would primarily accrue to Noranda. Neither utility rate payers nor the general public face a risk of higher costs associated with the transmission line if unexpected circumstances cause a change in planned mine operations.

Costs/Benefits

The initial cost of building a line to the mine would be between $3.1 million and $3.3 million, depending on which route is chosen (Table 4-58). Annual operating and maintenance costs normally would be $1,400 to $1,600. Noranda would pay the cost of building, operating, and maintaining the line.

Reliability Considerations

Power outages at the mine would not cause safety problems but would have costs. Noranda plans to have back-up generators with capacity of 7 MW at the mine site. This would be adequate power to maintain ventilation, pumping, and lighting in the

Table 4-58. Costs of various transmission line components.

Cost component	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Transmission line				
Length (miles)	16.7	16.7	16.3	17.3
Construction cost ($ million)§	3.24	3.24	3.17	3.19
Annual maintenance ($)	1,400	1,400	1,400	1,500
Extra line losses/yr† ($)	300	300	0	900
Life cycle cost ($ million)	2.64	2.64	2.57	2.79
Substations* ($ millions)				
Sedlak Park	1.63	same	same	same
Ramsey Creek	2.81	same	same	same

Source: Noranda Minerals Corp. 1989c.

§Includes a 10% contingency. All costs are estimates.

†All routes have line losses. The value given is the difference between losses for the given route and Alternative 5, the shortest route.

*Costs for substation equipment are preliminary estimates which may change due to final engineering design work being done by Noranda and BPA.

mine, but would not allow any mining or ore processing. A power outage would shut down the ore processing equipment, and up to an hour would be needed to restart it after even a very short outage (E. Netherton, Electrical Engineering consultant, Redpath Engineering Corp., January 3, 1990).

The number of poles that would be located at altitudes where snow accumulations of 2, 4, and 6 feet are likely is shown in Table 4-59. Alternatives 1 and 4 cross less high altitude terrain than the Alternatives 5 and 6 routes. A higher, more exposed route would be more likely to suffer from a major lightning-caused outage and might be more subject to problems from snow and ice build-up, although there is not enough data to quantify these differences. Deep snow also may make access to the line expensive in winter. Snow accumulation in the project area increases rapidly with altitude. Conventional snow plows could open access roads covered by up to two or 3 feet of snow, but deeper snow or drifts would have to be removed with truck- or tractor-powered snow blowers. This is slower

Table 4-59. Approximate number of poles above critical altitudes.

	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Below 3,600 feet (less than 2 ft snow)	51	44	43	44
3,601 to 4,000 feet (2 to 4 ft snow)	11	12	4	8
4,001 to 4,500 feet (4 to 6 ft snow)	28	28	20	17
Above 4,501 feet (over 6 ft snow)	3	2	16	19
	93	86	83	88

Source: Compiled by Department of Natural Resources and Conservation
Based on snow course survey information from Soil Conservation Service, Bozeman, MT.

and much more expensive than plowing. Plowing costs about $3 per mile while blowing snow costs about $0.30 per cubic yard (Miller, 1990).

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM RESOURCE PRODUCTIVITY

Short-term and long-term effects from the construction and operation of the Montanore Project area are described in the preceding resource sections. Irreversible and irretrievable commitment of resources also is discussed under each resource area. This section documents the agencies' analysis of the effects on long-term productivity of resources following project cessation and subsequent reclamation.

Project operations would be short-term, with mining expected to last for about 16 years following a three-year construction phase. Long-term resource productivity would be reduced in the tailings impoundment area and along access roads. Reclamation probably would not restore the premining productivity of these areas. Water quality following operations is uncertain. Neither the mine nor the tailings are expected to be acid-forming. Tailings water quality would slowly improve with time. It is not known how long ground water quality would be affected by tailings seepage. Treatment may be required in perpetuity if water quality standards would be violated by tailings seepage or post-operations discharge. The tailings impoundment would be a permanent facility, affecting the long-term visual and recreational resources.

5

COMPARISON OF ALTERNATIVES

THE alternatives analyzed in this EIS were developed in response to the significant issues identified during scoping. The agencies identified six significant environmental issues to drive the development of alternatives and evaluation of impacts—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quantity and quality of water resources and effects on aquatic life.

Table 5-1 provides a side-by-side comparison of the effects of the three mine alternatives and the no action alternative; Table 5-4 compares the effects of four transmission line alternatives. Detailed descriptions of these alternatives are given in Chapter 2, and a detailed discussion of their impacts is in Chapter 4.

Alternative 1 is the mining operation and transmission line as proposed by Noranda. Alternative 7 is a No Action alternative—in other words, permits would be denied and the Montanore Project would not be constructed. If neither of these alternatives is selected, the agencies would select from among two mine alternatives (Alternative 2 or 3) and three transmission line alternatives (Alternative 4, 5, or 6).

CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES

As proposed, the Montanore Project would result in significant impacts in three areas—surface water

Table 5-1. Comparison of mine alternatives by significant environmental issue.

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Water Resources						
Surface water quality	Slight increases in most metals and total dissolved solids concentrations in project area streams from seepage and discharges during operations. Surface water quality standards for nitrates, ammonia, and manganese projected to be exceeded. Ability to meet surface water quality standards for certain metals uncertain. Noranda would construct a tailings seepage interception system consisting of a series of wells downstream of the impoundment, reducing the amount of seepage reaching surface water. Acid drainage uncertain, but not expected. Comprehensive monitoring plan implemented.	Impacts similar to Alternative 1; slight reduction in potential sediment production with modifications of diversion channel. Increased monitoring of aquatic life, surface and ground water resources during operations. Additional testing required for assessing acid generating potential.	Tailings impoundment fully lined and collected tailings water used in mill during operations. All excess mine and adit water mechanically treated; treated water applied to a land application disposal area. Nitrate, ammonia and metals concentrations at or near ambient concentrations.	Tailings impoundment unlined; gravel drains or similar system installed. Tailings seepage would affect Libby Creek. Excess water with elevated nitrate concentrations mechanically treated; treated water and other excess water applied to a land application disposal area. Projected total nitrogen concentration less than 1 mg/L in all streams.	Tailings impoundment unlined; gravel drains or similar system installed. Storage of excess water and seasonal discharge to land application disposal areas along Ramsey Creek and Little Cherry Creek. Maximum projected total nitrogen concentration in Libby Creek is 1.7 mg/L. Additional monitoring implemented. Some soil uptake (attenuation) of metals would occur.	Existing surface water quality maintained. No increase in sediments. Libby Creek adit site reclaimed in accordance with DSL permit.
Ground water quality	Ground water quality standards for nitrates may be exceeded during construction phase and following operations. Tailings seepage would affect water quality during and following operations. Efficacy of Noranda's seepage interception system uncertain.	Ground water quality standards for nitrates may be exceeded during construction phase and following operations. Tailings seepage would affect water quality during and following operations. Gravel drains or similar system installed. Uncertainty associated with effects on ground and surface water quality reduced.	Impoundment lined; minimal effects on ground water from application of treated water to land application disposal areas.	Gravel drains or similar system installed; ground water effects in tailings impoundment area same as Alternative 2; minimal effects on ground water in land application disposal areas.	Gravel drains or similar system installed; ground water effects in tailings impoundment area same as Alternative 2. Nitrate concentrations reduced substantially by plant uptake.	Existing ground water quality maintained.
Surface water quantity	Slight increase of flow in Libby Creek during low flows; direct surface water withdrawals not anticipated. No subsidence or effects to surface water resources in Cabinet Mountains Wilderness expected.	Mine impacts same as Alternative 1. Surface water withdrawals, if needed, would not occur during average annual low flows.				No change in streamflows. No potential effects on Wilderness Lakes.

Table 5-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Wildlife						
Wildlife population and habitat	Physical disturbance of about 1,270 acres; displacement of big game and other wildlife species. Minor disturbance to land application disposal areas.	Winter closure of Big Hoodoo Mtn. Road for moose. Other mitigation would reduce indirect impacts, such as mortality. Other impacts the same as Alternative 1.	Same as Alternative 2 unless land application of treated water not required. Less displacement if land application not required.	Impacts the same as Alternative 2.	Increased land application of excess water in tailings impoundment area. Minor increased disruption of wildlife habitat.	No wildlife habitat affected.
Threatened or endangered species Impacts	Loss of 785 habitat units during mine operations, temporary effect to 562 habitat units during mine construction and 177 habitat units during transmission line construction. Temporary displacement of grizzly bears and increased mortality risk.	Impacts the same as Alternative 1 for mine alternatives. Difference in amounts of affected habitat during construction, depending on transmission line alternatives (see Table 5-4).				No changes in wildlife.
Proposed mitigation	Noranda would provide a letter of credit, trust fund, bond or similar financial instrument to ensure plan implementation. Replacement of habitat loss: 50% through KNF road closures; other 50% by acquiring land or conservation easements on suitable private land over a 6-year period. Salaries of two wildlife professionals funded for increased law enforcement and information and education (I&E) to reduce mortality rate.	Mitigation funded through bond. Noranda would provide yearly payments for new positions. Other mitigation measures, such as bear-proof garbage containers and removal of road kills, would reduce human/grizzly bear contact. Replacement of habitat loss: 35% through KNF road closures; 65% by Noranda's acquiring land or conservation easement at management committee direction over a 6-year period. Salaries of two wildlife professionals funded for life of project for increased law enforcement and I&E.				No mitigation necessary.

Table 5-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
General Forest Activities						
Recreational opportunity and use	Displacement of recreational users from Libby, Ramsey and Poorman drainages. Increased use at Howard Lake Campground and Libby Creek Recreation Gold Panning Area. Road closures would modify motorized recreational opportunity to semi-primitive, non-motorized recreational opportunity.	Impacts similar to Alternative 1. Fewer road closures in agencies' grizzly bear mitigation plan. Noranda would accomplish or fund the following mitigation— Improvements made at the Libby Creek Recreation Gold Panning Area if use warrants; and Roadside tree management program developed to obscure views of tailings impoundment and increase views of Cabinet Mountains.				No displacement of users. Developed recreational area use remains at current levels. Bear Creek Road not widened.
Other forest uses (also see Wildlife)	Temporary disturbance of about 1,270 acres; Tailings impoundment and widened Bear Creek Road right-of-way unsuitable for timber harvesting following operations. Increased traffic on Bear Creek Road (500%); road widened to accommodate increased traffic, increasing access. Moderate or high visual impact from project facilities to key viewpoints within forest.	Traffic reduced by car-pooling or busing. New management area developed for tailings impoundment, plant site, and transmission line corridor. Other impacts same as Alternative 1.				Existing multiple uses in project area remain.

Table 5-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Cabinet Mountains Wilderness						
Opportunity for solitude and primitive recreation	Recreational users of upper Ramsey Creek (~75 summer users) displaced. Project facilities would affect views of wilderness peaks climbers (~150 people).	Impacts same as Alternative 1.				Current wilderness experience remains unaffected.
Natural integrity and apparent naturalness	Increased concentrations of air-borne pollutants in upper Ramsey Creek. Expected levels well below applicable standards. Increased noise levels, particularly during construction, in upper Ramsey Creek. No visibility impacts. No subsidence or effects on surface water resources in Cabinet Mountains Wilderness expected.	Some noise reduction in wilderness through mitigation measures, such as modification of backup beepers on equipment. Increased monitoring of ground water resources and air quality during operations. Other impacts the same as Alternative 1.				Natural integrity and apparent naturalness maintained. Water resources in wilderness not at risk.
Tailings impoundment						
Stability	Tailings embankment would remain stable even in the event of a maximum credible earthquake. Artesian conditions would be controlled using a passive system of pressure relief wells (~110 by Year 16). Little Cherry Creek diverted around tailings impoundment facility.	Noranda would institute the tailings dam and impoundment monitoring program described in Appendix B. Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigation would provide more detailed information on artesian pressures within the embankment area.				No project facilities constructed.
Location	Would eliminate large population of northern beechfern (USFS-designated sensitive species). Would reroute Little Cherry Creek and eliminate 3 percent of available miles of habitat of Interior redband trout.	KNF would develop conservation plan for remaining northern beechfern on Forest. Noranda would fund habitat improvement and restoration work for Interior redband trout.				Habitat for northern beechfern and Interior redband unaffected. Continued hybridization of Interior redband.

Table 5-1. Comparison of mine alternatives by significant environmental issue (cont'd).

ISSUE	MINE ALTERNATIVES 1	2	3A	3B	3C	NO ACTION 7
Socioeconomics						
Employment	450 new jobs created directly by project and 200 indirect jobs during operation. Construction phase employment slightly higher.	Impacts same as Alternative 1. Noranda would develop written policies concerning local hiring and develop a worker training program.				No new jobs created. Existing high unemployment levels remain.
Population	Increase of 319 people for project life, less than 2 percent increase in Lincoln County. Peak increase of 411 people during construction phase.	Impacts same as Alternative 1.				No project-related population increase.
Income	$13.8 million in annual personal income during operation.	Impacts same as Alternative 1.				No increase in personal income from project.
Housing	A maximum of 153 housing units needed during construction; 110 housing units needed throughout project. Existing housing supply limited and some new housing development expected.	Impacts same as Alternative 1.				No new housing development. Existing housing adequate for current growth.
Community services	Increased need for law enforcement personnel and teachers.	Impacts same as Alternative 1.				No increased demand for community services.
Fiscal	Revenues allocated to local government units by Noranda would pay for increased costs through Impact Plan process.	Impacts same as Alternative 1.				Increased revenues and costs to governmental units would not occur.

quality, wildlife habitat, and general forest recreational activity. Some changes also would occur in the socioeconomic environment of Lincoln County and Libby, and in wilderness attributes in the Cabinet Mountains Wilderness. These changes are described in the following sections.

Changes in Water Quality & Effects on Aquatic Life

Water quality. Alternatives 1, 2 and 3 would result in a change in existing water quality. All alternatives would require an authorization from the Board of Health and Environmental Sciences to allow a change in nitrate and ammonia concentrations over ambient stream water quality. An authorization to allow a change in other water quality parameters, such as total dissolved solids or metals, also may be required.

Under Alternatives 1 and 2, increases in total dissolved solids, nutrients, and some metals would occur downstream of the project facilities. The agencies' analysis predicts that these increases would exceed surface or ground water quality standards for nutrients and some metals at some locations during the construction period and following mine operations. The agencies' analysis, however, is based on certain assumptions that may not reflect actual conditions and that cannot be known completely in advance. The agencies used assumptions that are reasonable, conservative, and protective of water quality. Several factors would affect surface water quality after Noranda's discharges. These include actual concentrations of ammonia, nitrates, and metals in both discharge waters and ambient streams, the influence of plant uptake and soil conditions on resulting ground water quality, and the exact locations where surface water quality would be affected. These factors lead to uncertainty over actual project effects; the uncertainty associated with the agencies' analysis is discussed in detail in Chapter 4 of the FEIS. Consequently, surface or ground water quality standards may not be exceeded during the project.

Under Alternative 2, Noranda would change the impoundment design with the objective of reducing the amount of tailings seepage entering ground water. The agencies have described one possible system, gravel drains, estimated to cost about $1.5 million. The system would reduce tailings pond seepage into ground water beneath the impoundment and provide a better opportunity to manage tailings water before entering ground water.

Three water management/treatment options (A, B, and C) have been described under Alternative 3. Under Option A, Noranda would place a synthetic liner beneath the impoundment and treat all excess water. Treated water would be either discharged to a land application disposal area, or discharged directly to area streams, depending on treated water quality. A discharge permit would be required if treated water is discharged directly to surface water. All tailings water probably would be used in the mill. Three "mechanical" water treatment systems—evaporator, reverse osmosis, and ion exchange—have been described and analyzed. Based on lining the impoundment and treating all excess water before, during and after operations with an ion exchange system, conceptual capital and operating costs would be about $27.5 million.

The evaporator system would be the most effective of the three systems considered in Alternative 3. Metals concentrations and nitrate concentrations would be reduced by 99 percent using an evaporator. Reverse osmosis would have similar removal efficiencies for metals, nitrates, and ammonia. Ammonia removal efficiencies in all three treatment systems, and removal efficiencies in general for the ion exchange demineralization system would depend upon specific operating conditions and influent water quality.

Mechanical treatment and subsequent land application treatment would meet applicable water quality standards for most parameters except for certain metals with concentrations which are below detection limits. It is unknown whether these systems would

achieve water quality standards for metals that have water quality standards below detection limits. Water quality standards also would be met using these systems for metals with water quality standards above detection limits.

Alternative 3B would require Noranda to treat all excess water having elevated nitrate and ammonia concentrations with a mechanical system prior to discharge. Conceptual capital and operating costs for an ion exchange system would be about $7 million. Under this option, the impoundment would not be lined. Noranda would change the impoundment design with the objective of reducing the amount of tailings seepage entering ground water. Water quality standards are projected to be met for most constituents; the uncertainty associated with certain metals also would be present under Option B.

Before implementing Alternatives 3A or 3B, Noranda would complete additional water quality analyses and prepare final system design for submittal to and approval by the agencies. Additional testing may be required to determine whether concentrations of parameters other than nitrates and ammonia would exceed ambient concentrations.

Noranda would construct additional land application disposal areas in the Little Cherry Creek area under Alternative 3C. Water would be stored during the non-growing season and discharged to land application disposal areas during the growing season only. Capital and operating costs for this option have not been estimated.

Nitrate and ammonia concentrations would be reduced substantially in comparison to year-round discharge to land application (Alternatives 1 and 2). Using the agencies' assumptions and a high range of nitrate and ammonia concentrations, total inorganic nitrogen is projected to exceed 1 mg/L in Year 3 of construction. Projected concentrations are below 1 mg/L using a low range of nitrate and ammonia concentrations. Effects on water quality in Little Cherry Creek are uncertain. The uncertainty associated with certain metals also would be present as discussed under Option A.

Under Alternative 3C, the Board of Health and Environmental Sciences would have to approve Noranda's petition as revised in the supplemental petition information (Noranda Minerals Corp., 1992a). The DHES will recommend to the Board that maximum concentrations of total inorganic nitrogen (nitrates, nitrites, and ammonia) in surface waters be limited to 1 mg/L.

Noranda would conduct additional analysis of adit and mine waters to determine the average nitrate and ammonia concentrations in these waters beginning with Year 1 of construction (discharge would be lowest in Year 1). Additional ground water monitoring also would be instituted in the land application disposal areas to evaluate the effectiveness of land application treatment. Based on this monitoring (described in Appendix B of the FEIS), the agencies would evaluate the likelihood that surface or ground water standards would be exceeded in subsequent years with increased discharged volumes (Years 2 and 3 of construction). If monitoring indicates that ground or surface water standards are or would be exceeded, Noranda would be required to modify its operating plan. Mechanical treatment using one of the three systems described under Alternative 3A could be required. Other less costly, but equally effective, modifications may be available.

The transmission line alternatives would have little effect on surface water resources. Alternative 7, No Action, would result in no effects on surface water quality. Discharges from the Libby Creek adit, which is permitted by the DSL under a separate action, would continue until closure. Adit closure would be in accordance with the existing permit.

Wetlands. Under Alternatives 1, 2, and 3, the Little Cherry Creek tailings impoundment would fill about 14 acres of wetlands and 5.8 acres of waters of the U.S. It is unknown if Noranda's proposed pressure relief/seepage collection system would affect

wetlands downstream of the tailings impoundment. Widening the existing Bear Creek access road would unavoidably fill and cause the direct loss of approximately 0.4 acre of herbaceous/shrub wetlands and less than 0.1 acre of waters of the U.S. Temporary indirect impacts to wetlands and waters of the U.S. would occur during construction due to increased sediment contributions to wetlands and waters of the U.S. Proposed best management practices would reduce sediment contributions to wetlands and waters of the U.S. No other mine facilities would affect wetlands or waters of the U.S.

Noranda has a proposed mitigation plan to create and expand wetlands. Suitable sites exist on- and off-site to develop new wetlands or to expand existing wetlands. Noranda's proposed wetlands monitoring plan would evaluate the success of the mitigation plan. Under Alternatives 2 and 3, the monitoring plan would be continued for a longer period. Intensive monitoring would be conducted every year as proposed by Noranda through Year 5. Less intensive monitoring would be conducted every two years thereafter through the end of production.

Also under Alternatives 2 and 3, additional wetlands would be replaced to mitigate for the uncertainty associated with parts of Noranda's proposal. Noranda also would implement additional fisheries mitigation to mitigate effects to Little Cherry Creek. Additional monitoring of wetlands downstream of the impoundment also would be conducted. No wetlands would be affected by Alternatives 4, 5, and 7. Alternative 6 would affect less than one acre of wetlands.

Fish and other aquatic life. Project area streams are typically low in bedload fine sediment. This is partly the result of high stream flows. The proposed project would result in slight increases in sediment loads and turbidity downstream of the proposed project. Under all action alternatives, impacts to fish and other aquatic life from increased sedimentation would be insignificant—to some extent, a limited increase in sediment to the streambed might actually benefit aquatic life at some locations.

The proposed diversion of Little Cherry Creek and placement of the tailings pond in Little Cherry Creek is estimated to cause a loss of 330 "cuttbow" trout. In addition, the project may affect other populations and habitat of these species due to the release of small gravels or fine sediments from the project area, if such releases are excessive beyond those typically occurring when best management practices to control sediments are implemented adequately.

Alternatives 1 and 2 would result in increased concentrations of minerals and nutrients, which would increase the productivity of many aquatic populations. Nutrients are projected to exceed aquatic life standards based on certain assumptions in the agencies' analysis. Increased algal growth could affect aquatic life adversely, particularly during periods of low flow. Not much is known about the effects of slightly increased metals concentrations on organisms inhabiting very soft waters, such as in the Libby Creek drainage. Baseline metals concentrations indicate some potential risk to aquatic populations, but the extent of risk is not known. Noranda's proposed discharge would increase metals concentrations in Libby and Ramsey creeks.

Under Alternatives 3A and 3B, some or all excess water would be treated with a mechanical system, reducing nutrient and metals concentrations in receiving streams. Secondary treatment would reduce nitrogen concentration at or below which may produce undesirable conditions for aquatic life. Noranda would implement an expanded monitoring program under Alternatives 2 and 3 to evaluate impacts to fish and other aquatic life. Using a high range of nitrate and ammonia concentrations in the analysis, projected concentrations of nitrogen under Alternative 3C during Year 3 would exceed those which may result in growth of undesirable aquatic life. Noranda would conduct additional monitoring and change its operating plans, if necessary, to ensure protection of fish and other aquatic life.

Changes in transmission line construction methods in Alternatives 4, 5, and 6 would slightly reduce the amount of sediment reaching the Fisher River and Ramsey Creek compared to Alternative 1. Existing conditions would be maintained with Alternative 7.

Monitoring. Under Alternative 1, Noranda would implement a water quality monitoring program designed to evaluate the effects of the Montanore Project on surface water quality. The monitoring program is also designed to develop information on water management, particularly on the quantity and quality of tailings impoundment seepage and mine and adit water. Noranda would revise the proposed water management plan in response to the monitoring information.

As part of Alternatives 2 and 3, the agencies have expanded the monitoring program in response to uncertainty perceived in Noranda's proposal. In addition to measures proposed by Noranda, the agencies would require Noranda to analyze excess water for additional metals which may have an environmental effect, and expand the aquatics monitoring to include toxicity testing of tailings, mine and adit waters, metals testing of fish, and evaluating fish populations. A more detailed water quality monitoring plan would be instituted under Alternative 3C.

Changes in Wildlife Habitat

The Cabinet Mountains provide habitat for a small population of grizzly bears, a threatened species. The project area also provides habitat for a variety of other big game wildlife, such as elk, moose, black bear and mountain goat. Project activities would displace these species from some habitat presently used in the area. An increased mortality risk to grizzly bears would result from direct and indirect effects of the project. Moose winter range would be affected in the proposed impoundment area. Effects from the mine, tailings impoundment, and related facilities would extend over the life of the project. Effects on wildlife from the transmission line would be confined mostly to the construction period. Alternative 6 would affect comparably less grizzly bear habitat than Alternatives 1, 4 or 5. New access roads for the transmission line would be closed following construction, and little activity would occur along the line during the operating phase. Elk security areas and big game winter range would be crossed by the transmission line route.

All action alternatives would require mitigation and compensation for effects on grizzly bears. These effects include loss of habitat and increased mortality risk. Two alternative grizzly bear mitigation plans are presented—one developed by Noranda and one by the agencies. Both plans would require Noranda to acquire habitat and to fund wildlife law enforcement and information positions, and the KNF to close roads. Both plans propose that a management committee be established to direct the mitigation program. This committee would consist of members from the U.S. Fish and Wildlife Service, the Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, and Noranda.

In Noranda's proposed grizzly bear mitigation plan, seasonal and year-round road closures would account for about 50 percent of needed habitat replacement. The other 50 percent would consist of private land acquisitions or conservation easements to be completed within six years of construction startup. Noranda would hold title to these lands or easements. Mortality risk would be reduced through the law enforcement and information positions, and through road closures.

The agencies' grizzly bear mitigation plan would apply to all action alternatives other than Alternative 1. Approximately 35 percent of lost habitat would be mitigated through road closures. The remaining 65 percent would be replaced by Noranda through purchase of private lands or conservation easements. Acquisitions would be completed within six years of construction startup, with 50 percent completed within the first three years. Mortality risk would be reduced through law enforcement and information

positions, road closures, and through additional measures to minimize the potential for human-bear interaction. The KNF is in formal consultation with the U.S. Fish and Wildlife Service regarding the proposed grizzly bear mitigation plan. The proposed mitigation plan and its effects could change based on the Fish and Wildlife Service's Biological Opinion.

Effects on wildlife resulting from the project would not occur under Alternative 7.

Changes in General Forest Recreational Activity

During the project construction phase, a significant increase in traffic would occur on the Libby Creek and Bear Creek roads under Alternative 1. The Bear Creek Road would be widened to accommodate the increased traffic. The increased traffic would likely affect recreational users who use the forest for travel and viewing pleasure, the primary recreational use in the project area. Road closures, both those proposed by Noranda and the agencies for grizzly bear mitigation, would reduce motorized recreational opportunity. These closures are in addition to the KNF road closures discussed in Chapter 2 to meet Forest Plan standards. Some of the roads proposed for closure are in areas managed for non-motorized recreation. Closure would increase semi-primitive, non-motorized recreational opportunity in these areas.

The tailings disposal facility (impoundment and dam) would be permanent and would affect the views of the Cabinet Mountains from several locations along Libby Creek Road. Although Noranda's proposed reclamation plan would likely result in reforestation of the impoundment area, the landform created by the facility would remain visually and topographically incongruent with the surrounding landscape.

Other project facilities, such as the plant site and transmission line, also would be visible from locations within the Cabinet Mountains Wilderness. The transmission line would be visible from the Libby Creek Recreation Gold Panning Area and the Howard Lake Campground.

Under Alternatives 2 and 3, Noranda would develop an agency-approved traffic management plan designed to minimize traffic on the access roads during all phases of the project. This mitigation would significantly reduce traffic levels on the Bear Creek Road.

Noranda would implement several modifications to address potential visual effects as part of Alternatives 2 and 3. The two primary modifications are developing three additional viewpoints along the Bear Creek and Libby Creek roads with views focusing on the Cabinet Mountains and developing a roadside tree management program with the goal of obscuring any project facilities along primary travel routes. Under these alternatives, Noranda would fund improvements at the Libby Creek Recreation Gold Panning Area if warranted by increased use.

Location and Stability of Tailings Impoundment

Tailings would be disposed in an impoundment spanning Little Cherry Creek, requiring a permanent diversion of the creek around the impoundment. A large population of northern beechfern, a USFS-designated sensitive plant species, would be lost. Noranda's proposed mitigation under Alternative 1 includes transplanting the plants in the impoundment area to undisturbed areas. The success of the proposed transplantation is uncertain. Under Alternatives 2 and 3, Noranda would fund broad-scale inventories for northern beechfern on the KNF, to assess its status more accurately. The KNF would develop a conservation strategy based on the accumulated field survey information. As part of this conservation strategy, the KNF would provide permanent protection for other known beechfern populations on the Forest. Although some transplanting could be conducted as part of an experimental program, transplanting would not be included as mitigation or compensation for the project.

Artesian ground water conditions occur in the impoundment area. Noranda proposes to relieve upward pressure through a pressure relief/seepage

interception system. The agencies conclude that a pressure relief system would ensure long-term impoundment stability. Under Alternatives 2 and 3, the agencies would require Noranda to collect additional information prior to final design of the pressure relief well system. Before final design, Noranda would collect additional subsurface data downstream of the dam alignment to better identify existing water-bearing strata. Noranda also would install a redundant ground water monitoring system including the use of multiple nested, open-well piezometers and pore pressure transducers. Additional monitoring and investigations would provide more detailed information on artesian pressures within the embankment area.

Changes in the Socioeconomic Environment

Operation of the Montanore Project would create 450 new jobs, and increased business activity in Lincoln County would create another 200 jobs. Employment during the three-year construction phase would be slightly higher. About $13.8 million in annual personal income would result from project operations. A long-term population increase estimated to be 319 people would be less than two percent of the present population in Lincoln County. A peak population increase of 411 people would occur during the construction phase. Increased housing and community services would be necessary to accommodate increased growth. An estimated 90 housing units would be needed by project workers and their families during the operations period; 105 housing units would be needed during the construction phase. No work camps would be developed. Under the Hard Rock Mining Impact Plan, Noranda would pay for all increased costs to local government units resulting from the project. Under Alternative 7, these socioeconomic changes would not occur. Existing high unemployment levels would likely remain.

Changes in Cabinet Mountains Wilderness

The proposed project would be near the Cabinet Mountains Wilderness, with the proposed plant site and adits adjacent to the wilderness boundary in Ramsey Creek, and the mine extending underneath the Cabinet Mountains Wilderness. Current recreational users of the Ramsey Creek drainage seeking the opportunity for solitude and primitive recreation would likely be displaced. Access to upper Ramsey Creek above the plant site would be restricted. During operations, project facilities would affect the views of climbers of some wilderness peaks (~150 people per year).

Increased noise levels, particularly during construction, and increased concentrations of air-borne pollutants would occur in upper Ramsey Creek. Levels of air-borne pollutants are expected to be well below applicable standards. No surface subsidence and no effects to surface water resources are expected in the wilderness.

Under Alternatives 2 and 3, some noise reduction would occur through mitigation. Increased monitoring would occur for surface and ground water resources, and for air quality around the proposed plant site. The transmission line alternatives would not affect wilderness characteristics. Under Alternative 7, the current characteristics of the Cabinet Mountains Wilderness would remain. Areas around the proposed plant site would not be affected.

Additional Analysis Associated with the Transmission Line Alternatives

The Board of Natural Resources and Conservation (BNRC) will select a route through contested case hearing proceedings discussed in Chapter 1. In selecting a preferred route and final centerline, the BNRC would use preferred route criteria established by administrative rules. Preferred route criteria encourage the use of public lands for a transmission line and require the best achievable balance among a number of environmental and location factors. Table 5-2 lists the preferred route criteria adopted by the BNRC.

Table 5-2. Preferred transmission line route criteria.

Criteria	Comment
The use of public lands for location of the facility was evaluated and public lands were selected wherever their use is as economically practicable as the use of private lands and compatible with environmental factors.	Criteria generally favors locations on public lands if economically practicable and compatible with 75-20-503 MCA which lists environmental factors to be considered where applicable to a transmission line. These environmental factors are analyzed in Chapter 4 of the EIS. The BNRC must balance various factors and select the route that minimizes impacts.
Located where there is the greatest potential for general local acceptance of the facility.	Criterion reflects public comment on agencies' analysis presented in the Draft EIS.
Located to use or closely parallel utility or transportation corridors.	This criterion applies to highways and transmission lines larger than 50-kV. Criterion generally favors locations that use or share existing right-of-ways. Use of U.S. 2 right-of-way was not considered in detail by the agencies due to the proximity of the Fisher River and residences. No utility corridors cross the main project area.
Allows for selection of a centerline in nonresidential areas.	Residential areas generally are areas of platted subdivisions with 5 or more residences per 20 acres.
Located on rangeland rather than cropland and on non-irrigated or flood-irrigated land rather than mechanically irrigated land.	Criterion relates to locations that provide for safe operation of mechanical irrigation equipment.
Located in logged areas rather than undisturbed forest, in timbered areas.	Criterion favors location in clearcut areas.
Located in geologically stable areas with non-erosive soils in flat or gently rolling terrain.	This criterion favors locations on gently rolling terrain with non-erosive soils.
Located in roaded areas where existing roads can be used for access to the facility during construction and maintenance.	Criterion generally favor locations along or within 1/4 mile of a road.
Located to avoid structure locations on a floodplain	Considers locations first to avoid floodplains; where floodplains must be crossed, considers locations that minimize impacts from structure locations across floodplains.
Located where the facility would create the least visual impact.	Considers visual impacts over length of the route.
Located a safe distance from residences and other areas of human concentration.	Considers short- and long-term safety of humans at work, home, and play.
Located in accordance with applicable local, state, or federal management plans when public lands are crossed.	Criterion favors routes that would best meet management objectives of the KNF Forest Plan (1987).

Sources: Rule 36.7.2531 (1) of Administrative Rules of Montana, and
Section 75-20-301 (2)(i) of Montana Codes Annotated.

Table 5-3. Compliance of the transmission line alternatives with adopted route criteria.

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	COMMENTS
Best use of public lands.	9.3 miles public lands; 7.2 miles Champion (56% public)	9.4 miles public lands; 7.2 miles Champion (56% public)	9.1 miles public lands; 7.2 miles Champion (56% public)	11.3 miles public lands; 5.6 miles Champion; 0.4 miles other private (65% public)	All routes would have moderate level of compliance with this criterion. No clear preference.
Greatest potential for local acceptance.	Visual concerns for residences along U.S. 2. Concerns for mining claims along Libby Creek.	Visual concerns along U.S. 2.	Same as Alternative 4.	Same as Alternative 4. Visual and land use concerns at Fisher River crossing.	Extent of general public acceptance would favor Alternatives 4 and 5.
Use or closely parallel U.S. 2 right-of-way.	One crossing of U.S. 2.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	All alternatives would have low level of conformity to this criterion.
Allow centerline selection in non-residential areas.	No developed residential areas crossed. Individual residences nearby.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	All routes would allow a centerline to be located in undeveloped rural area.
Flood irrigation rather than mechanical irrigation.	None crossed.	Same as Alternative 1.	Same as Alternative 1.	0.2 miles of flood irrigation along Fisher River.	All alternatives would avoid mechanically irrigated cropland.
Logged areas rather than undisturbed forest.	Crosses 2.9 miles of logged lands; 13.7 miles forested; 17% across logged areas.	Crosses 2.8 miles of logged lands; 13.9 miles forested; 17% across logged areas.	Crosses 3.7 miles of logged lands; 12.6 miles forested; 23% across logged areas.	Crosses 5.1 miles of logged lands; 12.0 miles forested; 29% across logged areas.	Alternatives would have low to moderate conformity to this criterion. Favors Alternative 6.
Geologically stable areas in non-erosive soils on flat or rolling terrain.	About 10% of route attains balance sought by this criterion.	Same as Alternative 1.	Same as Alternative 1.	About 5 percent of route attains balance sought by this criterion.	Study area includes gently sloping valley floors with erodible soils and steep mountainous terrain. Neither route would attain an optimum balance of this criterion.

Table 5-3. Compliance of the transmission line alternatives with adopted route criteria.

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	COMMENTS
Uses existing road for access.	0.6 miles of route more than 1/4 mile from existing roads. Estimated 15.1 miles of new access roads required.	Similar to 1 except that estimated 7.7 miles of new access road required.	0.5 miles of route are more than 1/4 mile from existing roads. Estimated 6.8 miles of new access road.	All of 17.3-mile route within 1/4 mile of existing roads. Estimated 6.1 miles of new access road required.	Alternatives 4, 5 and 6 would make good use of existing roads. Criterion would slightly favor Alternative 6 over Alternatives 4 and 5.
Avoid structures on 100-year floodplain.	Three structures on relatively stable area of Fisher River floodplain.	Same as Alternative 1.	Same as Alternative 1.	Six structures on floodplain of Fisher River where there is evidence of recent channel movement.	A crossing of the Fisher River floodplain cannot be avoided. Alternatives 4 and 5 would minimize impacts on floodplains.
Where facility would have least visual impact.	1.7 miles of high; 5.3 miles of moderate; 6.8 miles of low; 2.5 miles of very low impacts.	0.7 miles of high; 4.3 miles of moderate; 9.0 miles of low; 2.7 miles of very low impacts.	0.7 miles of high; 4.1 miles of moderate; 7.8 miles of low; 3.7 miles of very low impacts.	0.7 miles of high; 4.4 miles of moderate; 6.2 miles of low; 6.0 miles of very low impacts.	Alternatives 4, 5 and 6 would have overall low visual impacts.
Facility located a safe distance from residences and other areas of human concentrations.	Yes	Yes	Yes	Yes	All routes would provide for a location that is safe for people and human activity.
In accordance with KNF Forest Plan (1987).	6.2 miles of route conflict with management area direction in plan.	6.1 miles of route conflict with management area direction in plan.	3.7 miles of route may conflict with management area direction in plan.	4.2 miles of route conflict with management area direction in plan.	Alternatives 5 and 6 best meet current direction of KNF Forest Plan. All routes would require changes to some individual management areas.

The DNRC and the KNF considered these criteria during the preparation of the FEIS when analyzing impacts and comparing the transmission line alternative routes in Chapter 4. In evaluating and comparing the alternative routes, the DNRC and the KNF noted both similarities and differences in how well each route met the preferred route criteria. Table 5-3 presents a summary comparison of the alternative routes based on the BNRC-preferred route criteria and impact analysis contained in Chapter 4.

Alternatives 4, 5, and 6 offer environmentally sound locations for the transmission line and minimize environmental impacts considering the nature and economics of the alternatives. Alternative 1, construction of the transmission line as proposed by Noranda, would result in the greatest environmental effects due to the use of a crawler tractor rather than a helicopter to pull the sock line during initial stringing operations.

As shown in Table 5-1, differences among the three transmission line alternatives are not significant. The agencies identified six issues that were important in selecting among the transmission line alternatives (Table 5-4). Because of the small differences in impacts, the DNRC and the KNF recognize that the importance placed on these issues could change the ranking of a preferred alternative. The first issue was minimizing impacts on the Howard Lake area, an area identified by KNF as an important recreational site. The second issue was related to minimizing effects of alternative crossings of the Fisher River, considering river channel stability and the degree to which the alternatives would affect jurisdictional wetlands at the river and other locations. Third was minimizing the effect of the transmission line on private property along the various routes. Fourth was reducing management conflicts for siting the transmission line to the extent practicable in compliance with standards established in the KNF Forest Plan. The fifth issue involved minimizing to the extent practicable sedimentation and erosion from project disturbances. Sixth, the agencies considered the differences the alternatives would have for balancing the construction effects on the grizzly bear with other project effects.

Alternatives 5 and 6 would be farther from the Howard Lake and upper Miller Creek area than Alternative 4 and would have fewer visual effects on recreational users of the area.

Alternatives 4 and 5 would cross the Fisher River in a more desirable location than Alternative 6, avoiding the more active part of the river channel. Except for the Fisher River crossing by Alternative 6, jurisdictional wetlands would not be a significant issue on any of the alternatives due to the small size of identified wetlands and opportunities to avoid the areas when sites are chosen for structures and roads.

Alternatives 4 and 5 would better avoid impacts to private land at the Fisher River crossings. Alternative 6 would affect small parcels of private land without providing much opportunity to reduce impacts through centerline adjustments.

All alternatives would affect old growth habitat. The amount of clearing along Alternatives 4 and 6 would be more than that required by Alternative 5.

Alternative 5 would require more new road construction than Alternative 6, but less than Alternative 4. The differences in total miles of new road construction required for the line construction is not significant, and the measures to be required for construction of the line would minimize the potential for erosion and sedimentation along any of the alternatives.

Effects of construction and operation of the transmission line on grizzly bears would be relatively small. All alternatives would cross areas managed by the KNF for the benefit of the grizzly bear. Effects on grizzly bears would be limited largely to the construction period. Alternative 6 would have the least effects on grizzly bear habitat. This alternative would require the fewest miles of new access roads. It also would have the lowest level of activity in the upper Miller Creek basin. The Miller

Table 5-4. Comparison of selected impacts by transmission line alternatives.

FACTOR	ALTERNATIVE 1	4	5	6	COMMENTS
Miles of high and moderate visual effects Miles of low visual effects Miles of very low visual effects	7.0 6.8 2.5	5.0 9.0 2.7	4.8 7.8 3.7	5.1 6.2 6.0	Alternatives 4, 5 and 6 would have 0.7 miles of line with high visual effects along U.S. 2. Alternative 1 would have 1.7 miles of high visual impacts due to additional disturbance during line stringing.
Miles of public land crossed Miles of Champion land crossed Miles of other private land crossed	9.3 7.2 0.1	9.4 7.2 0.1	9.1 7.2 ---	11.0 5.6 0.4	
Changes required to KNF Plan - total acres for reassignment to transmission line use	369	369	224	254	KNF would adopt new management area (MA 23) covering acres affected along the selected alternative.
Total acres of tree clearing	193	203	183	200	Each route would affect at least one old growth stand less than 50 acres in size. The number of these small stands would increase as follows: Alternative 1 (4); Alternative 4 (3); Alternative 5 (1); and Alternative 6 (2).
Acres of old growth habitat removed	50	61	46	74	
Acres of old growth habitat affected (clearing and fragmentation)	130	202	140	155	
Old growth habitat < 50 acres	6-7	6-7	2-3	3-4	
Miles of road on erodible land types	4.1	1.6	1.4	1.0	DNRC and KNF would approve final design.
Miles of road on other land types	11.0	6.1	5.3	5.0	
Number of perennial streams requiring new crossings	5	1	0	0	All perennial streams could be crossed using existing bridges, except Miller Creek, where the bridge was washed out. Under Alternative 1, 5 streams would be crossed by a crawler tractor used to string the line.
Number of structures on designated floodplains	2-3	2	1	1	Crossings of designated floodplain on Fisher River would require review by the DNRC and Lincoln County Disaster and Emergency Services Coordinator.
Number of intermittent streams crossed by centerline	20	19	16	10	Intermittent streams are shown on 7.5 minute quadrangle USGS maps.
Number of intermittent streams crossed by roads	15-16	5-6	5-6	5	More streams crossed by Alternative 1 due to the use of crawler tractor for line stringing.

Table 5-4. Comparison of selected impacts by transmission line alternatives (cont'd).

FACTOR	ALTERNATIVE 1	4	5	6	COMMENTS
Jurisdictional wetlands affected (acres)	0	0	0	<1	The Swamp Creek alternative would affect less than 1 acre wetland. Other wetlands would be avoided.
Effects on grizzly bear					
habitat units temporarily affected during construction	177	177	463	198	Mainly short-term impacts during construction; proposed mitigation includes timing restriction on line construction during spring.
miles of transmission line in grizzly bear habitat	8.9	8.9	6.5	3.6	
miles of new access road in grizzly bear habitat	4.7	4.7	4.1	1.2	All access roads in grizzly bear habitat closed following construction.
Total miles of elk security area crossed by—					All new roads built for transmission line construction would be closed to public travel.
line	1.8	1.6	1.3	0.3	
roads	3.0	1.4	0.8	0.1	
Total miles of big game winter range crossed by—					Construction timing would be used to avoid impacts to animals using winter range.
line	3.8	4.4	3.6	0.4	
roads	2.8	2.6	2.0	0.3	

Creek basin is a relatively large drainage on the east side of the Cabinet Mountains with an abundance of low elevation early season habitat components. Secure areas on the east side of the Cabinet Mountains are very important for bears during the early spring period, when other foraging options are very limited. Road closures proposed by the Forest Service to comply with Forest Plan standards, along with closures proposed as mitigation for the Montanore Project, are targeted at reducing motorized access in this drainage, particularly during the spring.

The adjacent Midas Creek basin also has some of the same features as Miller Creek, with the presence of extensive graminoid sidehill parks on the west-facing side of Horse Mountain. Alternative 6, however, would affect a smaller portion of this upper basin area, with the line located over one mile south of the sidehill park complex on Horse Mountain. This upper basin area of Midas Creek also would be crossed by Alternative 5.

Appendix H provides a listing of sensitive areas identified for each of the three alternatives. Sensitive areas are locations along each route where special mitigation would be applied through DNRC's Environmental Specifications. The measures identified for the selected alternative would be incorporated into environmental specifications approved for the project and be monitored by the DNRC during construction. The KNF may develop a separate but coordinated monitoring program for National Forest System lands.

THE AGENCIES' PREFERRED ALTERNATIVES

Mine Alternative

The agencies' preferred alternatives are Alternatives 3C and 5. Alternative 3C would result in construction of the mine, mill, tailings pond, land application disposal areas and access roads. Excess water would be stored and discharged seasonally to

land application disposal areas along Ramsey or Little Cherry creeks. Environmental requirements in addition to those proposed by Noranda would be incorporated to minimize or eliminate environmental impacts. Additional monitoring would help detect unacceptable impacts, should they occur. Measures would be developed to respond to and control these impacts.

Recommended Transmission Line Route and Centerline

In evaluating the alternatives, the DNRC and the KNF considered the analysis documented in this FEIS. Based on a weighing and balancing of the information contained in the FEIS, the DNRC and the KNF recommend Alternative 5 as providing the best balance for a route and centerline. Alternative 5 would result in construction of the North Miller route transmission line, and associated facilities, to provide power for the mine and mill.

6 METHODS

THE analysis in this EIS has involved the evaluation of a great deal of information on the land, resources, and people of the project area. Under the requirements of the Montana Metal Mine Reclamation Act, the Montana Major Facility Siting Act and the U.S. Forest Service's mineral regulations (36 CFR 228), Noranda was required to collect sufficient information to allow an evaluation of the environmental impacts of the proposed project. In cooperation with the agencies, Noranda developed study methods, described in detail in a Plan of Study, for the various environmental resources (Noranda Minerals Corp., 1988a). The methods used by Noranda in the collection of baseline information are summarized in the Baseline Data Collection section. Environmental baseline information collected by Noranda is contained in their various applications and is available for public review at agency offices. In addition to baseline data collection, Noranda has been conducting interim monitoring of various environmental resources. Interim monitoring is discuss in Chapter 2.

The agencies are responsible for the analysis of the environmental baseline information and the assessment of impacts described in Chapter 4. In some instances, such as evaluation of dam stability or assessment of ground water impacts, Noranda prepared an analysis which was subsequently reviewed by the agencies. The methods of analysis for the various resources are described in the Impact Assessment section.

BASELINE DATA COLLECTION

Noranda began collecting baseline data in 1988. This section describes the methods used during the initial year of data collection. For some resources, such as water quality, interim monitoring has continued. Interim monitoring is described in Chapter 2.

Meteorology and Climate

Meteorological monitoring was conducted at two sites—the proposed tailings impoundment area (referred to as the Little Cherry Creek site) and the proposed plant site (referred to as the Ramsey Creek site). The Montana Air Quality Bureau approved the selection of these two monitoring sites. Wind speed, wind direction, temperature, and stability class were recorded at both sites. At the Little Cherry Creek site, precipitation, relative humidity, solar radiation, and evaporation were also recorded. Published climatological information used to describe the area's climate came from the National Oceanic and Atmospheric Administration, the National Weather Service, and the Soil Conservation Service.

Air Quality

Data collection for the plant site was begun by U.S. Borax in the spring of 1988 and continued by Noranda. Meteorological and air quality monitoring equipment were co-located at Ramsey Creek and Little Cherry Creek. Measurements at the Ramsey Creek site included—

- PM-10 particulate matter less than 10 micrometers (µm) in diameter;
- wind speed;
- wind direction; and
- temperature.

Two PM-10 high-volume samplers were located about 6 feet apart on top of a shelter with the sampler inlets 8 feet above the ground. The wind sensors and a temperature device were located on a 10-meter (33-foot) tower. The wind sensors were mounted at the top of the tower and the temperature sensor at the 4-meter level. It was not possible to locate the temperature device any lower because of the potential for burial during snow storms.

The types and configuration of monitoring equipment at the Little Cherry Creek site were similar to the Ramsey Creek site. In addition, relative humidity and solar radiation were measured using devices located 9 meters from the ground. Measurements at the Little Cherry Creek site included—

- PM-10;
- total suspended particulates (TSP);
- wind speed;
- wind direction;
- temperature;
- relative humidity;
- solar radiation; and
- precipitation.

Information gathered during the monitoring period of July 1, 1988 through June 30, 1989 at these two locations was compiled and reported as—

- monthly and annual temperature means;
- temperature extremes;
- wind speed and wind direction frequency distributions;
- atmospheric stability classifications, using sigma-theta values and the methodology outlined in Woodward-Clyde Consultants, Inc., 1989a;
- monthly and annual precipitation means;
- monthly and annual relative humidity means; and
- annual evaporation value (using wind speed, temperature, relative humidity and solar radiation).

Geology/Geotechnical

Geologic investigation of the mine area was conducted by U.S. Borax prior to Noranda's involvement with the project. A total of 29 core holes were drilled from nine separate sites within the known deposit area between 1983 and 1987. Depths of the borings ranged from a few hundred feet to more than 4,500 feet. Geologic information obtained from the drilling program was used to determine structure and stratigraphy of the ore body and overlying rock. Samples were collected for geochemical, mineralogical and rock strength evaluations. Samples of the ore, barren zone material and tailings generated in a bench-scale test were analyzed for acid-base potential to determine if the materials would be acid generating. Surficial geologic mapping also was conducted.

Geotechnical investigations were conducted by Morrison-Knudsen Engineers, Inc. in 1988, 1989 and 1990. The purpose of these investigations was to gather information necessary to evaluate alternative locations for the plant, mine adits, evaluation adits, and the tailings impoundment. Several sites were investigated in detail including—

- plant site and mine adit sites—Ramsey Creek and Libby Creek;
- evaluation adit sites—the Heidelberg Tunnel, the south end of Rock Lake, and the Upper Heidelberg Road; and
- tailings impoundments sites—Little Cherry Creek, Poorman Creek and Midas Creek.

Mapping from aerial photography was conducted to identify landslides and avalanche chutes. Following Noranda's selection of Little Cherry Creek as the preferred tailings impoundment site, more detailed investigations were undertaken. Field investigations consisted of geologic mapping, seismic surveys, drilling, and test pit evaluation. Soil samples from borings and test pits were collected for geotechnical analysis. Field permeability tests were conducted during drilling. Monitoring wells were completed in selected borings. The results of the investigations were used to describe the geologic setting, seismicity (including seismic design criteria), other geologic hazards, and subsurface site conditions (including depth to bedrock and depth to ground water).

The tailings impoundment was sized to completely contain run-off resulting from a 24-hour general storm probable maximum precipitation (PMP) plus snowmelt. The PMP is defined theoretically as the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a certain time of the year. The 24-hour general storm PMP plus snowmelt for the Little Cherry Creek watershed utilized for design has a total precipitation depth of 15.8 inches (Noranda Minerals Corp., 1989a).

Since all runoff upstream of the proposed diversion dam would be routed around the tailings impoundment via the diversion channel, only the tailings impoundment drainage area (which includes the impoundment area) was used to estimate the required inflow volume for containment (Morrison-Knudsen Engineers, Inc., 1989c). The tailings dam would be incrementally raised to maintain the storage capacity necessary for storage of the design storm. An additional freeboard of 3 feet would be maintained above the peak flood water surface associated with the design storm. The agencies reviewed and analyzed the design calculations prepared for Noranda for accuracy and consistency.

In 1990, Noranda conducted further geotechnical, geological, and hydrological investigations at the Little Cherry Creek impoundment site. The geological investigations consisted of additional geologic mapping at the proposed main dam and diversion dam sites. Springs not previously observed were also mapped.

Additional exploration drilling and test pits were completed at the impoundment site (Morrison-Knudsen Engineers, Inc., 1990b). The 1990 field exploration consisted of 27 boreholes and 47 test pits. The borings were used to determine the characteristics of bedrock and soils, depth to ground water and depth to bedrock. Hole depths ranged from 37 to 354 feet. Field tests were performed in all borings to determine consistence and permeabilities of the subsurface materials. Piezometers were installed in most borings to measure ground water levels. Test pits were used to evaluate subsurface conditions and to characterize proposed borrow materials. Soil samples for laboratory analyses were collected where conditions permitted.

Noranda provided the agencies with supplemental information on geotechnical investigations conducted in the mine area, mine planning and backfill (Redpath Engineering, Inc., 1991). The geologic setting of the mine area was developed from drill-hole data and surficial geologic mapping. Laboratory analysis of rock strength characteristics were conducted on samples from drill cores. Pillar stresses and pillar strengths were estimated based on accepted methods;

computer modelling was used to calculate stress redistribution that would result from underground openings. Noranda personnel also evaluated several large room-and-pillar mines in the United States and Canada to compare operating conditions with their proposed plan.

Noranda collected samples from drill cores and analyzed them for their acid-base potential. Samples of ore, rock 5 and 20 feet above and below the ore zones, and the barren zone between the two ore zones were collected and analyzed. Noranda also has collected samples of waste rock during construction of the Libby Creek evaluation adit. These samples were analyzed for acid-base potential. A total of 168 samples were collected and analyzed.

Hydrology

Hydrologic baseline investigations in the project area were initiated by U.S. Borax and completed by Noranda. U.S. Borax conducted its own surface water quality sampling program on the Rock Creek drainage beginning in June, 1986, and on the Libby Creek drainage in September, 1987. A more comprehensive hydrologic baseline investigation plan was developed by U.S. Borax and Chen-Northern, Inc., and approved by the DSL and the KNF. Additional hydrologic investigations began in April, 1988.

Surface water investigations included flood plain mapping, streamflow measurements, and water quality sampling. Flow measurements were made by Chen-Northern, Inc. at 21 sites between April and October, 1988, and at eight sites for the winter program between November, 1988 and April, 1989 (Figure 6-1). A permanent stream gaging station, equipped with a continuous flow recorder and ISCO water sampler to collect daily suspended sediment samples, was constructed on Libby Creek downstream of the project area.

Surface water samples were collected along with streamflow measurements. These samples were analyzed for major and minor ions, nutrients, metals, and sediment. Specific conductance, pH, and temperature were measured in the field during sampling.

Ground water investigations included an inventory of wells, springs, and adits during the summer of 1988. A geophysical reconnaissance (electrical resistivity method) of the tailings impoundment area was conducted to determine depth to water and the configuration of the bedrock surface. Eight monitoring wells (one well is a dual-completion well for monitoring at two depths) were completed in the tailings impoundment area.

Static water levels were measured in the wells in August and October, 1988, and in January and March, 1989. Ground water quality samples were collected at the same time. Samples were analyzed for concentrations of total recoverable metals. Measurements of pH, specific conductance, water temperature, and redox potential were made in the field. Aquifer tests were performed on all wells to determine the hydraulic permeability and transmissivity of the aquifer.

In September 1991, Noranda installed five ground water monitoring wells in the Ramsey Creek percolation pond area. These five wells plus the existing well would be used in the operational monitoring program. Well completion followed methods used for previously installed wells.

Estimates of adit water inflow by Chen-Northern, Inc. (Noranda Minerals Corp., 1989b) were reviewed by the agencies. Inflow estimates were calculated using the following equation—

$$Q_o = \frac{2\pi\ K\ H}{2.3 \log (2H/R)} \times 7.48$$

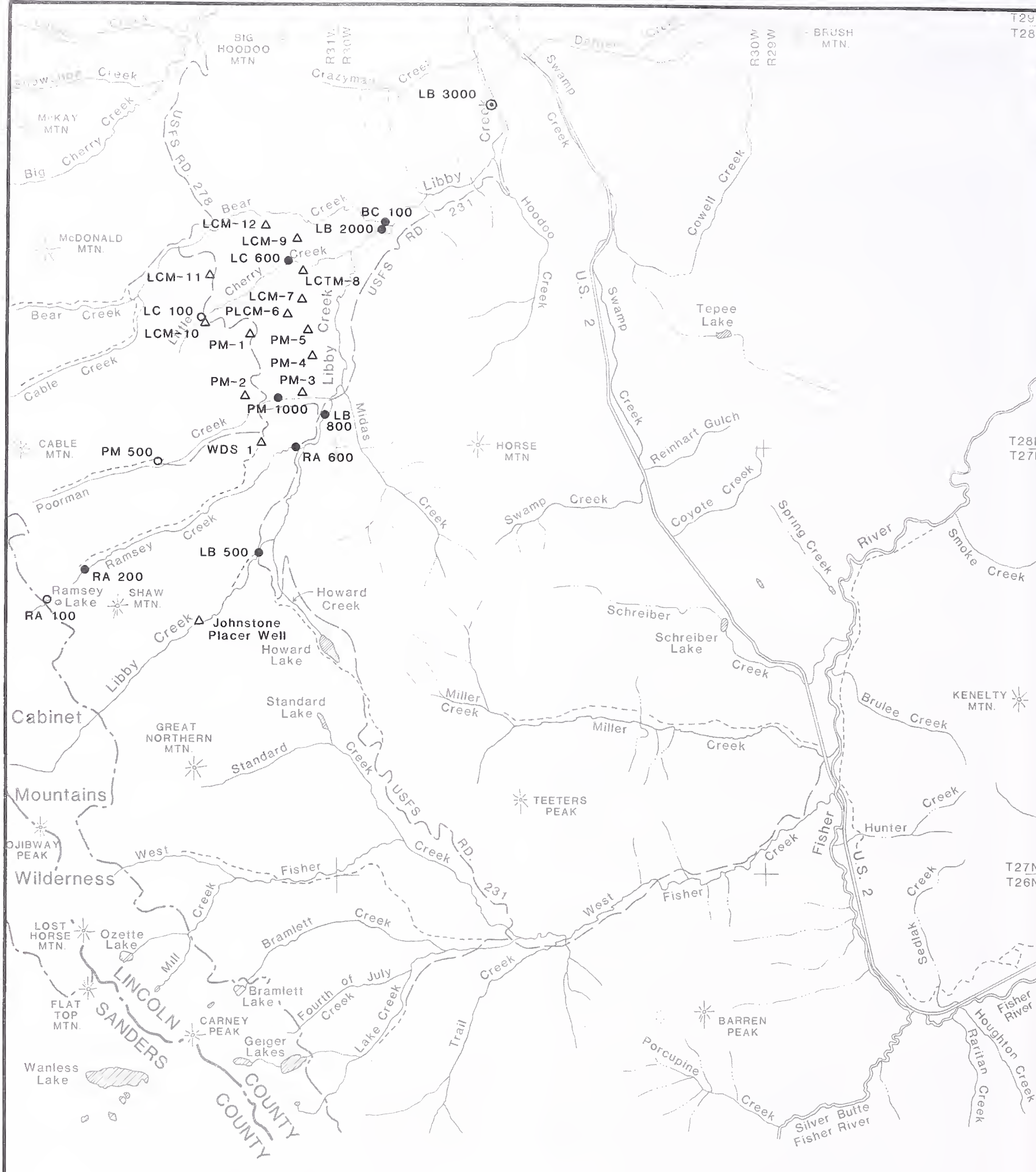
Where—

Q_o is the ground water inflow per unit length of tunnel (gpm/ft.),

K is the hydraulic conductivity (ft./min),

R is the tunnel radius (ft.), and

H is the hydraulic head measured as the vertical distance from the adit to the overlying water table.



Source: Chen-Northern, Inc. 1989.

LEGEND

Surface Water Sampling Sites

- ● Staff/Crest Gages
- ○ No Gages
- ⊙ Continuous Recorder
- △ Monitoring Well

NORTH

0 1 2 MILES

FIGURE 6-1.

BASELINE HYDROLOGIC MONITORING LOCATIONS

Hydraulic conductivity values were obtained from bedrock aquifer tests conducted by ASARCO at the site of the proposed ASARCO tailings pond at the confluence of Rock Creek and the Clark Fork River, (Noranda Minerals Corp., 1989b). Hydraulic conductivities ranged from 7.8 x 10^{-5} cm/s to 3 x 10^{-6} cm/s, and had an average value of 2.35 x 10^{-5} cm/s. Since fracture porosity and permeability decrease with depth, the hydraulic conductivity was decreased one order of magnitude for each 1,000 feet below ground surface.

The hydraulic head was determined from the depth below the regional water table. The exploration holes in the Rock Lake area encountered stable water conditions at a depth of 500 feet below ground surface (Noranda Minerals Corp., 1989b). This depth corresponds to an elevation of 5,400 to 5,500 feet, which is assumed to be the regional water table.

Ground water inflow to the Libby Creek adit and the Ramsey Creek adits was calculated on a segment by segment basis (Table 6-1). Except for the initial segment, each segment was 2,000 feet long. The Libby Creek adit was assumed to be 16,800 feet long, to have an 8-foot radius, and to have portal elevation of 4,010 feet. The Libby Creek adit would be essentially horizontal. The Ramsey Creek adits were assumed to be 13,000 feet, to have a radius of 30 feet, and to have a portal elevation of about 400 feet above the Libby Creek adit. Because adit radius occurs in a logarithmic term in the tunnel inflow equation, the adit size does not have a large effect on the inflow estimate.

Total estimated inflows into the adits are 392 gpm (202 gpm from the Libby Creek adit and 190 gpm

Table 6-1. Adit inflow calculations.

Adit segment (ft.)	Hydraulic head (ft.)	Adit level K (ft./min.)	Calculated average Q_o (gpm/ft.)	Segment inflow (gpm)	Cumulative inflow (gpm)
Libby Adit (r=8 ft.)					
0-2,800	150	3 x 10^{-5}	0.0584	164	164
2,800-4,800	350	3 x 10^{-6}	0.0110	22	186
4,800-6,800	750	5 x 10^{-7}	0.0034	7	193
6,800-8,800	1,250	1 x 10^{-7}	0.0010	2	195
8,800-10,800	1,600	7 x 10^{-8}	0.0009	2	197
10,800-12,800	1,800	6 x 10^{-8}	0.0008	2	199
12,800-14,800	2,050	3 x 10^{-8}	0.0005	1	200
14,800-16,800	1,650	6 x 10^{-8}	0.0008	2	202
Ramsey Creek Adits (r=30 ft.)					
0-1,000	150	5 x 10^{-5}	0.1532	153	153
1,000-3,000	350	3 x 10^{-6}	0.0157	31	184
3,000-5,000	1,100	1 x 10^{-7}	0.0012	2	186
5,000-7,000	1,900	3 x 10^{-8}	0.0006	1	187
7,000-9,000	2,550	8 x 10^{-9}	0.0002	1	188
9,000-11,000	2,600	1 x 10^{-8}	0.0002	1	189
11,000-13,000	2,400	3 x 10^{-8}	0.0007	1	190

Source: Noranda Minerals Corp. 1989b. Attachment 2.

from the Ramsey Creek adit). The majority of the inflow comes from the segment nearest the surface, and decreases significantly with depth.

In addition to the adits, inflows may result from other sources including inflow into deep mine workings, additional drifting not estimated, and inflows from individual geological structures (Noranda Minerals Corp., 1989b). Inflows from these sources were estimated to contribute an additional 560 gpm. Calculations by the agencies using the adit inflow formula concurred with Noranda's estimate.

Wetlands

Noranda conducted an additional field survey to identify and characterize jurisdictional wetlands during the summer of 1991. This work was conducted for areas that would be potentially disturbed by surface facilities of the Montanore Project and for selected areas of proposed transmission line alternatives. The survey used methods described in the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee for Wetland Delineation, 1989). In compliance with current Corps of Engineers' directives, jurisdictional wetlands presented in Chapter 3 are based on the 1987 U.S. Army Corps of Engineers' *Wetland Delineation Manual* (Environmental Laboratory, 1987).

The 1991 survey included an analysis of stereo aerial photographs and topographic maps of the study area, field mapping of hydric soils, and characterization of vegetation. Noranda prepared a map delineating identified wetland areas and a report describing wetland types and the function and value of project area wetlands.

Aquatic Life and Fisheries

Physical habitat characteristics were analyzed for 24 reaches in five project area streams—Little Cherry Creek, Poorman Creek, Bear Creek, Ramsey Creek and Libby Creek. Macroinvertebrates (aquatic insects) populations were sampled three times from 18 reaches between August, 1988 and April, 1989. Interim monitoring of macroinvertebrates and other physical and biological characteristics has continued since 1989.

Physical habitat features at the 24 stream reaches within the project area were classified using a generalized geomorphic approach agreed to in the field with agency personnel. Results from August, 1988 stream surveys were analyzed using the Forest Service's General Aquatic Wildlife System (U.S. Forest Service, 1985) "level 3 assessment" to determine Riparian Habitat Condition, Habitat Vulnerability Index, and Habitat Condition Index values for each stream reach. Also, percent available spawning and rearing areas were determined for each reach.

Macroinvertebrates were collected using a fine mesh Hess sampler from 17 stations in the Libby Creek drainage during August and October, 1988 and April, 1989. Samples were analyzed to determine total population density and biomass, number of taxa (richness), Shannon diversity, biotic index, plus several other community measures based on numbers and kinds of benthic macroinvertebrates at each site on each sampling date.

To determine possible fall spawning activities in Libby Creek, 26.1 miles of stream upstream from its confluence with the Kootenai River were surveyed during late September and October, 1989. Personnel from the Montana Department of Fish, Wildlife, and Parks (DFWP) sampled fish populations in Libby, Ramsey, Poorman, and Little Cherry creeks during August and September, 1988. Two and three-pass electro-shocking techniques were used. The results of these sampling surveys are presented in Noranda's permit application (Western Resources Development Corp., 1989a).

Wildlife

The wildlife study area comprises three increasingly larger areas—a 12.1-square-mile area, which included all potential mine development areas, a 30.8-square-mile intensive study area, and a 49.2-square-

mile extensive study area (Figure 6-2). Wildlife use of the transmission line corridor area was assessed during two helicopter flights and four vehicle surveys conducted between April and July, 1989. Additional information was obtained from the DFWP and the KNF. All small mammal and bird sample plots were within the potential development area, while big game studies were conducted in the extensive study area. Big game distribution, relative abundance and seasonal habitat use were determined by—

- systematic helicopter surveys;
- vehicle surveys;
- ground (pedestrian) surveys, including track counts;
- qualitative observations;
- literature review; and
- discussions with local DFWP and USFS biologists.

Breeding birds and small mammals were sampled on permanent plots in six major habitat types—riparian, western hemlock, mixed conifer, clearcut, shrubfield, and spruce fir. Breeding birds were sampled using strip transect methods and small mammals by trapping. Raptors, waterfowl and shorebirds were sampled in conjunction with the breeding bird surveys and other field work. Separate harlequin ducks surveys were conducted along suitable creeks.

No specific field surveys were conducted for species listed as endangered or threatened by the U.S. Fish and Wildlife Service (USFWS). Recent studies performed in the project area and data collected in conjunction with the other wildlife surveys were used as information sources. Use of the area by species of special concern was determined from data collected during other field work, recent reports, species habitat affinities, and distribution of suitable habitats. Species of special concern include species listed as threatened, endangered, or sensitive by the USFWS, the MDFWP, or the KNF.

Special surveys were conducted for harlequin duck, Coeur d'Alene salamander and boreal owl. The upper reaches of Libby and Ramsey creeks were surveyed for harlequin duck in mid-June, 1988. Boreal owl surveys were conducted by listening for and soliciting boreal owl calls during the peak of the calling season. Although 15 nights were spent in the field, weather conditions prevented these surveys from being really effective. Surveys were conducted of suitable Couer d'Alene salamander habitat along the Libby Creek and Bear Creek roads in September, 1989.

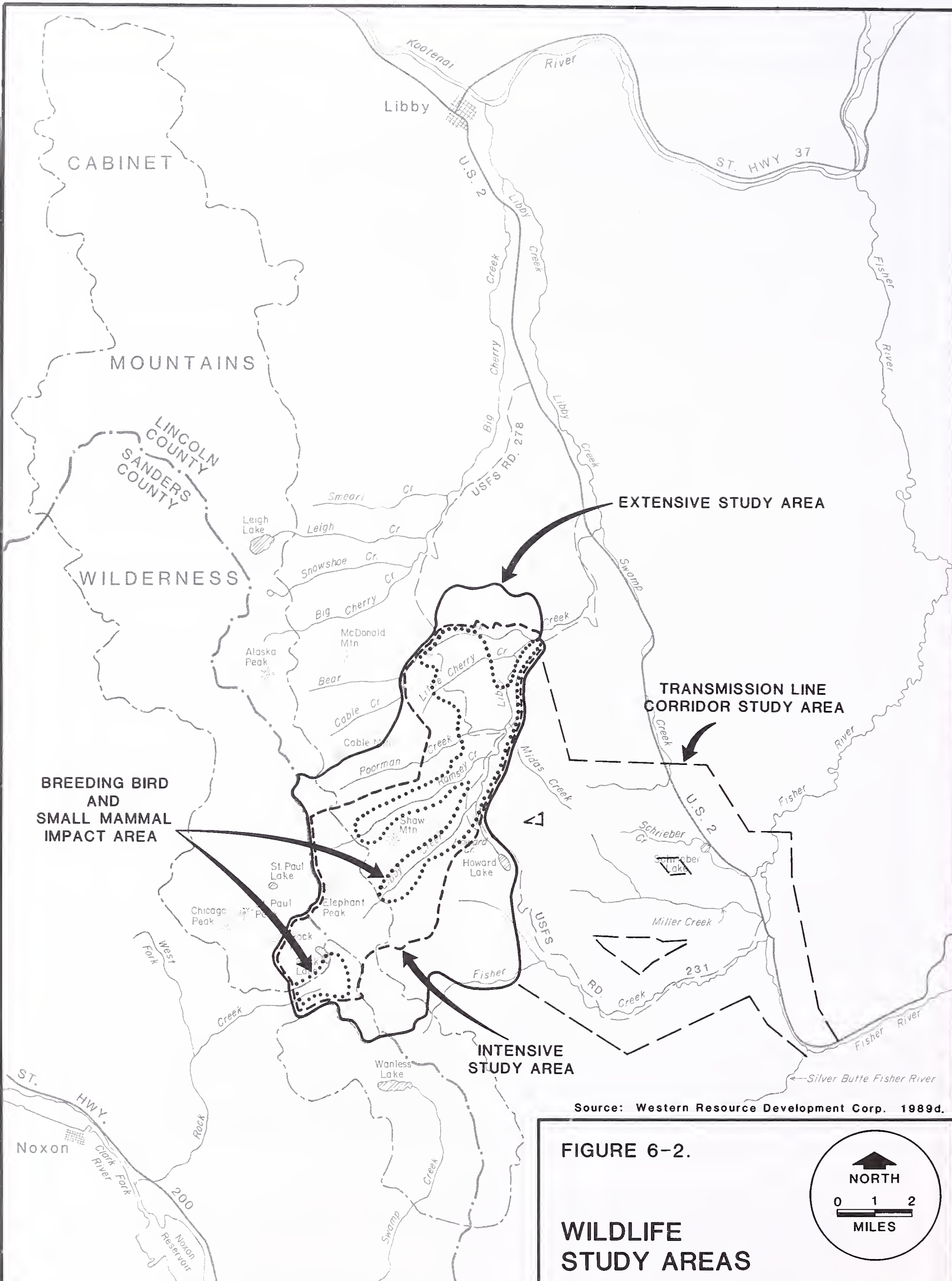
Soils

Noranda collected soils information at three levels of detail, depending on the anticipated level of disturbance. The three areas are the extensive study area, the transmission line corridor area, and the intensive study area. The intensive study area encompassed all mine areas proposed for disturbance.

The KNF Land System Inventory (Kuennen and Gerhardt, 1984), a mapping system that integrates soils and vegetation information, was the primary information source for the extensive study area and transmission line corridor area. Additional field investigations were also conducted for the corridors.

A detailed soil survey was conducted on about 2,300 acres, including all areas proposed for mine-related disturbance. Detailed soil surveys were designed to determine the location and extent of the major soils and to serve as guidelines in predicting the availability, quantity, and quality of soil materials suitable for salvage and reclamation use.

Surveys were conducted according to standard procedures employed by the USDA Soil Conservation Service and current DSL guidelines. Characteristics such as parent material, soil textures, and rock fragment content were used to distinguish soil types. Additional properties, such as slope steepness, surface soil textures, and the pattern of soils types on the landscape, were used to distinguish mapping units. Soils were identified and mapped on topographic maps and aerial photos at a scale of 1:4,800 (1 inch = 400 feet).



Source: Western Resource Development Corp. 1989d.

FIGURE 6-2.

WILDLIFE STUDY AREAS

Soil profiles were examined by excavating pits. Each soil profile was described in detail to 60 inches in depth unless bedrock or unsuitable salvage material was encountered first. Samples were collected from each major horizon (layer of soil) and analyzed by an independent laboratory.

Vegetation

The vegetation of the project area was mapped according to vegetation structure and species dominance. Quantitative information was collected on the vegetation of the mine area and qualitative vegetation information was procured for the transmission line corridors. Measurements included—

- vegetation cover;
- tree density, reproduction, diameter, basal area, volume and age;
- shrub density; and
- herbaceous production.

A point-intercept method was used for cover sampling and quadrat methods for density and herbaceous production. Sample sites were located in representative areas.

Vegetation in the transmission line corridor area was mapped using aerial photographs combined with field reconnaissance. Vegetation types were delineated according to the relative density of dominant overstory and/or understory woody species.

Land Use

Land use inventory information from the KNF, the DSL, and Lincoln County was used to describe baseline conditions.

Visual Resources

An inventory of visual resources was compiled from existing data available from the KNF. The visual resource inventory conducted by the KNF is known as the Visual Management System (VMS). The VMS included inventories of variety classes, sensitivity levels for travel routes, Visual Quality Objectives, and Visual Absorption Capability.

Sensitivity Levels classify the level of people's concern for the scenic quality of an area. Primary travel routes and use areas are classified as Level 1, highest sensitivity. Areas with a very low volume of users are classified Level 3, lowest sensitivity, and Level 2 sensitivity describes a moderate level. Visual analysis typically classifies views into foreground (up to 0.5 mile), middleground (0.5 to 3 miles), and distant or background views (over 3 miles). The dominance of visual changes to the landscape generally depends on how close the viewer is to the changes. View duration is also an important consideration. The primary use areas, such as destination peaks, and campgrounds, will typically have a longer view duration than primary travel routes.

KNF's objectives for the visual management of the land are expressed as Visual Quality Objectives (VQO) which indicate the level of the public's concern for visual quality. The "preservation" VQO prohibits any modification to the landscape, whereas "maximum modification" allows development to dominate over the characteristic landscape, if necessary. "Retention," "partial retention" and "modification" are VQOs that cover the range between these extremes.

For the proposed transmission line, visibility was evaluated for 18 observation points scattered throughout the project area. These points were in the wilderness, at recreation sites, on trails, and along the U.S. 2 corridor. This information was integrated with the visual inventory to assess impacts.

Four visual impact levels—high, moderate, low and very low—were determined at various sites by identifying and combining the level of contrast between the proposed transmission line and the landscape, considering the ability of the landscape to absorb transmission line related changes, and the scenic quality of the areas.

Transportation

Noranda collected information on the existing transportation system from published reports of the Montana Department of Highways and the U.S. Forest Service, and from personal communications with officials of the Montana Department of Highways, Lincoln County, and the KNF.

Socioeconomics

Historic and current socioeconomic information was collected and organized to follow DSL's *Plan of Operating Guidelines*. Information was collected for both Lincoln and Sanders counties. Primary categories of information included—

- social;
- cultural;
- population;
- housing;
- human health and safety;
- community and personal income;
- employment;
- tax base;
- demand on governmental services;
- industrial and commercial services; and
- environmental plans and goals.

Information was collected throughout 1988. Information sources included federal, state and local government agencies. Interviews with local officials and citizens also were conducted to determine key issues and concerns. Population projections through the Year 2010 were developed using a demographic/economic simulation model.

Cultural Resources

Cultural resources were assessed through a literature review and file search, and an intensive pedestrian survey of 3,587 acres of KNF, state and private lands which may be affected by the proposed project. Portions of the proposed access roads and transmission line corridors were included in the survey. Sections that crossed private lands were not examined during initial field work. These areas would be intensively inventoried for cultural resources once final road and transmission line corridors have been selected and access obtained to private lands.

The literature and records review included—

- examination of previous cultural resource reports for the project area, General Land Office (GLO) plats, mineral resource surveys, historic maps (such as land status maps) and site files at the Kootenai National Forest Supervisor's Office
- a check of the National Register of Historic Places (NRHP); and
- a search of the Montana Statewide Cultural Resource site files at the State Historic Preservation Office (SHPO).

Sound

Ambient noise levels were measured in September, 1988 near the two meteorological monitoring stations. The sampling program consisted of collecting 0.5-hour averages of A-weighted equivalent sound levels and calculating statistical properties of the noise data. In addition, an octave filter was used to collect instantaneous A-weighted sound levels at ten frequency bands. Ambient noise data were collected during daytime and nighttime hours for a weekday and weekend period.

IMPACT ASSESSMENT

Air Quality

As part of Noranda's air permit application, Noranda completed air quality computer modeling to predict impacts. Air quality impacts were estimated using EPA's COMPLEX I and Industrial Source Complex (ISC) computer models. Visibility impacts were determined using standard EPA screening analyses for Level I and Level II procedures. These procedures are described in the following sections.

Modeling. Computer simulation of the transport and dispersion of air pollutants is the principal approach

to evaluating the project's impact on air quality. Among the many computer models created for this purpose, the EPA has approved several for use as prescribed in its *Guideline on Air Quality Modeling* (EPA, 1986). Using approved models, the impacts of emissions of particulate matter, nitrogen dioxide, carbon monoxide, and lead were predicted using information available from the air quality permit application of Noranda (TRC Environmental Consultants, Inc. 1989). In addition, impacts of heavy metals—arsenic, antimony, cadmium, chromium, zinc, copper, and iron—were estimated on the basis of their observed presence in samples of airborne particulates.

The two proposed mine adits would be point sources, and lie in rough terrain; EPA's COMPLEX I model was used for these sources. The vicinity of the proposed tailings impoundment is much flatter, and has less need for a model that can account for the effects of complex terrain. Moreover, the tailings impoundment would be an area source, a type which cannot be modeled with COMPLEX I. The model used for the tailings impoundment was ISCST, which is approved by EPA for area sources.

Modeling assumptions. For any model, it is necessary to adopt a set of assumptions regarding meteorological variables put into the model. With the exception of wind speed and precipitation at Little Cherry Creek, meteorological data collected at the proposed project site during the period of July 1, 1988 through June 30, 1989 are assumed to represent normal weather conditions. Data used in the modeling were checked the agencies by comparing the information collected with other recorded air quality and meteorology values (i.e. Rock Creek and the town of Libby). All information was consistent with established baseline conditions in the region. The precipitation and wind speed information at Little Cherry Creek may be anomalous. Worst case assumptions were made in computing emission factors and dispersion for the tailings pond to compensate for this apparent anomaly.

Background pollutant concentrations are needed to determine the air quality resulting from the proposed project's modeled impacts. The background values used were obtained from baseline monitoring at the project site. For nitrogen dioxide and ozone, the background values were taken from data collected by the Montana Power Company near Great Falls, Montana (TRC Environmental Consultants, Inc. 1989).

The Ramsey Creek and Libby Creek sites are so similar that data collected at Ramsey Creek were used to represent both locations. Data for modeling the Little Cherry Creek site were collected there because the surrounding terrain is not similar to the Ramsey Creek and Libby Creek sites. The ISCST model was used to predict particulate impacts from the tailings pond in the Little Cherry Creek drainage. Because ISCST is a "flat terrain" model (pollutant sources lower in elevation than the surrounding terrain cannot be modeled), it was assumed that the surrounding terrain is at the same elevation as the tailings pond.

Emission estimates. Emission estimates used in impact modeling were derived from the EPA AP-42 handbook, *Compilation of Air Pollutant Emission Factors* (EPA, 1985). In some cases, standard emission factors were supplemented with project design information (TRC Environmental Consultants, Inc., 1989). The actual emissions from the proposed project would depend on the level of activity. The first two years of the project would be taken up in construction. Mining would begin during the second two years. The emission estimates are based on full production of 20,000 tons of ore per day, which is planned to begin in the third year of the mine life. Emissions of air pollutants would occur at four locations—the Ramsey Creek adit, the Libby Creek adit, the Ramsey Creek plant, and the tailings impoundment.

Emissions from the Ramsey Creek adit would originate in the mine. Sources would include primary crushing, coarse ore conveying, and combustion products from blasting, diesel exhaust,

and propane air heaters. Two jaw crushers would be used to crush waste rock and ore; their emissions would be controlled with a high-energy wet venturi scrubber. Emissions from other sources would be controlled by a combination of operating and maintenance practices designed to meet worker health protection standards and to reduce the ventilation requirements. Air emissions would be exhausted horizontally from the adit, with an expected flow rate of 700,000 cubic feet per minute.

The plant site would contain facilities for handling and grinding the coarse ore from the mine, and for handling the concentrate produced by the mill. Ore transfer to a coarse ore stockpile, and wind erosion of the stockpile would be sources of fugitive dust emissions. Dust from coarse ore handling would be controlled with a high-energy wet venturi scrubber. No dust emissions are anticipated from the mill as the material in process would be kept wet. Some dust would be emitted from concentrate handling, but the amount would be minimized by maintaining a high moisture content.

Emissions from the Libby Creek adit would consist of combustion products from blasting, diesel exhaust, and propane air heaters. Air emissions from the adit would be exhausted vertically, at an expected flow rate of 700,000 cubic feet per minute. As with similar emissions from the Ramsey Creek adit, these would be controlled by a combination of operating and maintenance practices.

The tailings from the mill, a slurry of finely divided solids, would be gravity-fed to the tailings pond at Little Cherry Creek. Tailings in the pond would be wet, and as water drained from these, part of the surface would dry out and become a source of fugitive dust, mainly in the summer months. Water sprinklers would be used to reduce emissions.

Impact estimates. The air pollutant emissions described above (TRC Environmental Consultants, Inc. 1989), were used to estimate the air quality impacts caused by the project. Although the proposed project is not subject to the federal Prevention of Significant Deterioration regulations, the definition of "significant" (with respect to emission rates) used in those regulations was employed to determine which pollutants to model (Table 6-2). On this basis, particulate matter, nitrogen dioxide and carbon monoxide were modeled for short and long-term impacts. Estimates of heavy metal impacts were based on the observed presence of the metals in samples of airborne particulates.

The particulate emissions modeled are those known as total suspended particulates (TSP). This term is defined by a standard sampling method, but is generally taken to mean airborne particles with a diameter of 30 μm or less. Currently, federal and state regulations are directed at particles of 10 μm or less (PM-10). Because emission factors for PM-10 emissions are generally not available, model results for TSP were compared to standards for PM-10. PM-10 is a subset of TSP; therefore this approach would tend to overestimate the PM-10 impacts. However, it is expected that most of the proposed project's estimated particulate emissions will be in the PM-10 range, so that any overestimate should be small.

Table 6-2. Comparison of emission rates with significant levels.

Pollutant	Emission rate (g/sec)	Emission rate (tpy)	Significant level (tpy)
TSP	0.4780	15.93	25
PM-10	0.3988	13.29	15
NO_x	4.2982	143.27	40
SO_2	0.6599	22.00	40
CO	5.7572	191.90	100
HC	0.2213	7.38	40
Pb	2.84×10^{-5}	0.001	0.6

Source: TRC Environmental Consultants, Inc. 1989. V. 1, p. 4-25.

Geology/Geotechnical

The agencies evaluated the mine area to determine if surface subsidence might occur as a result of mining (Agapito and Associates, Inc. 1991). This evaluation relied partly on information regarding the mine plan and rock mechanics studies submitted by Noranda (Redpath Engineering, Inc. 1991), and from published and other information on mine-related subsidence. The evaluation considered information on structure, stratigraphy, rock strengths, ore zone and overburden thicknesses, and mine plans. Two major modes of subsidence were considered—sinkhole and trough. Comparisons were made with other mines and mining districts. The potential for pillar failure and pillar punching was evaluated using standard industry practices.

The proposed tailings embankment in Little Cherry Creek was analyzed for both static and pseudostatic (seismic) stability using the computer program STABL (Siegel, 1975). Conservative soil strength parameters were used in the stability analyses to represent the various materials which comprise the embankment, including the dam earthfill and rock fill, foundation soils, cycloned sand tailings, and impounded pond tailings.

The stability of the upstream and downstream slopes of the starter dam were analyzed for the end-of-construction condition prior to tailings deposition. The stability of the downstream slopes of both the starter dam and the impoundment dams at the end of the project were analyzed for both steady-state seepage and seismic loading, using a conservatively high free water surface within the dam (Noranda Minerals Corp., 1989a). Minimum acceptable factors of safety for the various analyses were selected in accordance with recommendations of the U.S. Army Corps of Engineers (1970). A seismic coefficient of 0.1 g was utilized for the seismic analyses (Noranda Minerals Corp., 1989a). Results of the stability analyses are given in Table 6-3.

Supplementary static stability analyses of the tailings embankment were independently performed by the agencies. These analyses addressed the potential effect of excess pore pressures due to construction of the downstream raised tailings embankment with cycloned tailings sands. A summary of these analyses, including the major assumptions and factors considered in the analyses, is discussed in the following sections.

The starter dam, with a crest elevation of 3,500 feet, would be sequentially raised in the downstream mode through the use of tailings sands developed from two-stage cycloning of the tailings. The

Table 6-3. Results of stability analyses.

Loading condition	Embankment stage	Slope	Minimum acceptable factor of safety	Minimum computed factor of safety
End-of-construction	Starter dam	Upstream	1.3	1.41
End-of-construction	Starter dam	Downstream	1.3	1.55-2.02
Steady-state seepage	Starter dam	Downstream	1.5	1.62
Steady-state seepage	Final dam	Downstream	1.5	1.97
Design floor	Final dam	Downstream	1.4	1.65
Seismic	Starter dam	Downstream	1.0	1.23
Seismic	Final dam	Downstream	1.0	1.46

Source: Noranda Minerals Corp. 1989a.

proposed rate of rise is about 50 feet (up to a crest elevation of 3,550 feet) during the first two years of operations, or about 25 feet per year (Morrison-Knudsen Engineers, Inc., 1989b). This is the maximum rate of rise for the embankment, as the rate decreases with increasing time. Maximum excess pore pressures within the cycloned sands and starter dam would be associated with the maximum rate of building; therefore, the dam section chosen for analysis had a crest elevation of 3,550 feet.

The shear strength parameters assigned to the impounded tailings and coarse tailings sands were conservatively assumed based on experience with similar materials and on published summaries of test data for hard rock copper tailings (Vick, 1983; Volpe, 1979; Chen and Van Zyl, 1988). The strength parameters of the compacted earthfill and random rockfill of the starter dam were also conservatively assumed based on experience and published data for similar rockfill (Leps, 1970; Marsal, 1972; Donagne and Cohen, 1978). The strength parameters for the foundation soils were estimated based on the results of the geotechnical investigation completed by Noranda (Morrison-Knudsen Engineers, Inc., 1989a and 1989c). A summary of the strength parameters utilized in the stability analysis is presented in Table 6-4.

For the proposed situation of an embankment constructed in the downstream method and raised at the maximum rate of about 25 feet per year with cycloned sands, it can be safely assumed that the excess pore pressures will dissipate as rapidly as the load is applied (Vick, 1983), and will therefore have no adverse impact on the embankment stability. Excess pore pressures are considered to be critical to the stability of upstream raised embankments raised at the rate of about 50 feet per year or more, especially when relatively fine grained tailings are utilized (Vick, 1983).

A conservative excess pore pressure parameter of 0.2 (times the applied overburden stress) was selected for the cycloned tailings sands and compacted starter dam earthfill. The location of the phreatic (free water) surface was conservatively assumed to be located 10 feet below the crest of the embankment at the embankment centerline, corresponding to the assumed level of impounded fine tailings upstream of the embankment. The location of the phreatic surface within the downstream portion of the embankment was conservatively assumed to be much higher than would be expected within the relatively free-draining cycloned sands.

Shallow and deep-seated circular failure surfaces within the earthfill, tailings and foundation soils were analyzed using the computer program PCSTABL5 (Carpenter, 1985), utilizing the simplified Bishop

Table 6-4. Summary of soil shear strength parameters used in embankment stability analysis.

Description	unit weights: wet (pcf)	unit weights: saturated (pcf)	Effective friction angle (degrees)	Effective cohesion (psf)
Starter dam earthfill	124	133	33	0
Cycloned sand tailings	110	123	33	0
Starter dam rockfill	140	145	38	0
Foundation layer 1	125	135	35	0
Foundation layer 2	135	141	35	0
Fine tailings	100	110	0	500

Source: IMS Inc. 1990.

method. A static stability analysis of the downstream face of the year two tailings embankment was performed. Strength and other geotechnical parameters assumed for the analysis are as discussed in previous paragraphs. The resulting factor of safety from the stability analysis had a value of 1.54.

The computed factor of safety for the static stability analysis of the year two dam exceeds the generally accepted minimum value of 1.5 (U.S. Army Corps of Engineers, 1970). It should be noted that the assumed soil strength parameters and loading conditions (such as the height of the phreatic surface in the embankment) are considered to be very conservative relative to the actual conditions that are anticipated to exist.

The agencies conducted additional analysis and evaluation of the subsidence potential associated with the Montanore Project (J.F.T. Agapito and Associates, Inc., 1991). The evaluation consisted of reviewing Noranda's proposed mine plan (Noranda Minerals Corp., 1989a) and the supplemental information compiled by Noranda (Redpath Engineering, Inc., 1991). Selected literature on subsidence was also reviewed. The analysis described likely subsidence modes, and evaluated the subsidence potential associated with the project.

Hydrology

The locations of perennial streams were determined from USGS topographic maps. Locations of projected stream crossings for the transmission line without nearby bridges were determined by overlaying known and needed roads on the topographic maps and comparing locations of individual structures and roads to the locations of streams. Where a crossing of a perennial stream would be necessary for construction and maintenance, it was added to a list of stream crossings along each route. Further, the amount of surface disturbance within 200 feet of each perennial stream was tallied.

The agencies evaluated the potential subsidence effects of the mine on the surface water resources in the Cabinet Mountains Wilderness, particularly Libby Lakes, St. Paul Lake and Rock Lake. Effects were estimated based on proximity of mining to the lakes, the amount of overburden separating the mine workings from the lake bottoms, and the potential for intercepting faults beneath and adjacent to the lakes.

Water Quality

Loading analysis. Water quality impacts were estimated using a mass balance loading analysis. Four monitoring stations used in the baseline and/or interim monitoring program were selected as impact assessment locations (Table 6-5). Stations RA 600, PM 1000, and LB 2000 are located downstream of the Ramsey Creek land application disposal (LAD) area. It is uncertain where the shallow aquifer beneath the Ramsey Creek LAD discharges. Based on the measured ground water levels in the LAD area, Noranda estimates that 83 percent of the ground water would discharge to Ramsey Creek, 7 percent to Poorman Creek, and 10 percent to Libby Creek (Noranda Minerals Corp., 1992a). The loading analysis is based on these percentages. WDS-1, located in the center of the LAD area, is used to estimate ground water impacts.

Station LB 2000 also is used to estimate water quality impacts from tailings pond seepages. Ground water at the Little Cherry Creek tailings pond site currently discharges to Libby Creek and to Little Cherry Creek. Noranda has proposed to divert Little Cherry Creek around the tailings impoundment and to intercept tailings impoundment seepage and ground water at the tailings impoundment toe (see Chapter 2). As a result, flow in Little Cherry Creek downstream of the impoundment would be reduced, and lower Little Cherry Creek may cease to be a perennial stream. Station LB 2000 is located downstream of the confluence of Libby Creek and Little Cherry Creek. Therefore, seepage from the tailings pond, whether it discharges to Libby Creek

Table 6-5. Monitoring stations used in loading analysis.

Station	Location	Rationale
RA 600	On Ramsey Creek below the Ramsey Creek LAD area and upstream from the Libby Creek confluence	Provides estimate of surface water impacts from discharges to the Ramsey Creek LAD area
PM 1000	On Poorman Creek below the Ramsey Creek LAD area and upstream from the Libby Creek confluence	Provides estimate of surface water impacts from discharges to the Ramsey Creek LAD area
LB 2000	Downstream of tailings impoundment; upstream of the Crazyman Creek confluence	Provides estimate of surface water impacts from the tailings pond seepages and from discharges to the Ramsey Creek LAD area
WDS-1	In the center of the Ramsey Creek LAD area	Provides estimate of ground water impacts from discharges to the Ramsey Creek LAD area

or Little Cherry Creek, would affect water quality at station LB 2000.

For the purpose of the loading analysis, individual water quality concentrations were estimated using the following equation—

$$C_E = \frac{C_1Q_1 + C_2Q_2 + C_3Q_3 + C_4Q_4}{Q_1 + Q_2 + Q_3 + Q_4}$$

Where—

C_E is the estimated concentration at the impact assessment location;

C_1 is the observed concentration during baseline and/or interim monitoring;

Q_1 is the calculated streamflow under low flow conditions;

C_2 is the estimated adit water concentration;

Q_2 is the estimated adit water discharge;

C_3 is the estimated mine water concentration;

Q_3 is the estimated mine water discharge;

C_4 is the estimated tailings water concentration; and

Q_4 is the estimated tailings water discharge.

The agencies' estimates for these variables are discussed in the following sections.

Existing conditions—surface water. The agencies analyzed projected surface water quality impacts under low and average flow conditions (Table 6-6). Because of the short period of record, flows at the three stations were estimated using a proportional drainage area adjustment of reported flows in Granite Creek (USGS, 1982). Granite Creek is located about eight miles north of the tailings impoundment site. It has similar geology, vegetation, and soils as Ramsey Creek and upper Libby Creek.

Low flow conditions at the site typically occur in the early fall. Ambient concentrations from samples collected in the low flow period during the four-year monitoring period (1988-91) (Tables 6-7 and 6-8) were averaged and used to estimate average low flow concentrations for the loading analysis. Because of the very low analyte concentrations, some of the samples have quality assurance problems. These values were not used in the analysis. The ambient silver concentration reported for station LB 2000 (0.0003 mg/L) was used in the loading analysis. The analytic detection limit was used in the analysis when all reported values were below detection limits, or had quality assurance problems. The detection limit concentration may be slightly or considerably higher than the actual concentration. Concentrations for average flow were developed using the average concentrations of all samples at each monitoring location (Noranda Minerals Corp., June 5, 1991; revised June 24, 1991).

Table 6-6. Stream low flow rates used in loading analysis.

	Drainage area (mi^2)	7-day 10-year low flow Reported (cfs)	7-day 10-year low flow Projected (cfs)	Average annual flow Reported (cfs)	Average annual flow Projected (cfs)
Granite Creek	23.6	5.0	—	70.0	—
RA 600	6.7	—	1.4	—	19.9
PM 1000	6.0	—	1.3	—	17.8
LB 2000	41.0	—	8.7	—	121.6

Source: Noranda Minerals Corp. 1989h. revised June, 1991—on file with the agencies.

Table 6-7. Ambient surface water quality during low flow conditions at two monitoring stations.

Parameter	LB 2000 Oct. 1991	LB 2000 Sept. 1990	LB 2000 Sept. 1988	PM 1000 Oct. 1991	PM 1000 Aug. 1989	PM 1000 Sept. 1988
	(mg/L)					
Flow (cfs)	8.81	13.15	5.8	1.63	2.2	0.7
Total dissolved solids	40	17C	41	15	32BCR	29
Hardness	34.7	26	26	14	<12	10
Alkalinity	34	28C	34	17	16	20
Ammonia	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate/nitrite	0.73	0.47	0.03B	0.04	0.05B	0.04B
Sulfate	3	2	2	2	2	2
Aluminum	<0.1CZ	<0.1	<0.1	<0.1CZ	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001CZ	<0.0001	0.0007ABCZ	<0.0001CZ	<0.0005BCZ	<0.0019ABCZ
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.001	0.001CZ	<0.001	0.001	0.001	0.002
Iron	<0.05	<0.05CZ	<0.05	<0.05	<0.05	<0.05
Lead	<0.001	0.002CZ	<0.001	<0.001	<0.001	<0.001
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	<0.0002AZ	0.0032AZ	0.0003	<0.0002AZ	<0.0002	0.0004
Zinc	<0.02	0.04CRZ	<0.02	<0.02	<0.02	<0.02

Sources: Chen-Northern, Inc. 1989; 1990; 1991a; 1992. Metals concentrations are total recoverable.

Notes: A–blind field standard outside advisory range
B–bottle blank equal to or above detection limit
C–cross-contamination blank equal to or above detection limit
R–field duplicates outside expected range
Z–value not useable for statistics

Noranda began discharging adit inflows from the Libby Creek adit in January 1990. The September, 1990 nitrate concentrations have been affected by these discharges. Consequently, the September, 1990 nitrate concentrations are not used to calculate average ambient water quality conditions. Water quality monitoring during low flow has not detected increases of other parameters (Table 6-7).

In 1991, Noranda collected samples from selected monitoring locations and analyzed the samples for selected metals at lower detection limits than those previously used in the baseline and interim monitoring programs (Table 6-9). The results of these lower detection limit analyses show undetectable or very low concentrations of lead, mercury, and silver in the surface water samples collected. (Mercury was also detected in the cross-contamination blank and, therefore, may have been introduced during sampling.) Arsenic was not detected at the lower detection limit.

Existing conditions—ground water. Noranda calculated ground water flux (movement) beneath the LAD area to be 254 gpm based on Darcy's Law (Q=kia) and the following data and assumptions—

Table 6-8. Ambient surface water quality during low flow conditions at the Ramsey Creek monitoring station.

Parameter	RA 550 Oct. 1991 (mg/L)	RA 600 Sept. 1990 (mg/L)	RA 600 Sept. 1989 (mg/L)	RA 600 Sept. 1988 (mg/L)
Flow (cfs)	1.21	5.29	4	1.4
Total dissolved solids	14	<1C	12B	15
Hardness	5	<7	<7	<6
Alkalinity	6	6C	7	8
Ammonia	0.23	0.06	<0.05	<0.05
Nitrate/nitrite	0.06	0.07	0.06C	0.07B
Sulfate	6	1	1BC	2
Aluminum	0.1CZ	<0.1	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001CZ	<0.0001	<0.0001	0.0010ABCZ
Chromium	<0.02	<0.02	<0.02	<0.02
Copper	<0.001	<0.001CZ	0.006BC	0.002
Iron	<0.05	<0.05CZ	<0.05	<0.05
Lead	<0.002	0.002CZ	<0.001	<0.001
Manganese	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05
Silver	<0.0002AZ	0.0001AZ	<0.0002AZ	<0.0002
Zinc	<0.02	0.01CRZ	<0.02CZ	<0.02

Sources: Chen-Northern, Inc. 1989; 1990; 1991a; 1992. Metals concentrations are total recoverable.

Notes: A–blind field standard outside advisory range
B–bottle blank equal to or above detection limit
C–cross-contamination blank equal to or above detection limit
R–field duplicates outside expected range
Z–value not useable for statistics

Table 6-9. Total recoverable metals concentrations using lower detection limits at selected monitoring stations.

Parameter/lab†	Requested detection limit	LB 200	LB 300	LC 600 (mg/L)	LB 2000	LB 3000	CCB-100§
Arsenic	0.001						
CNI		<0.001	<0.001	—	<0.001	<0.001	<0.001
RMA		—	<0.01	<0.01	<0.005	—	—
Lead	0.0005						
CNI		<0.0005	<0.0005	—	0.0008	<0.0005	<0.0005
RMA		—	<0.01	<0.005	<0.005	—	—
Mercury	0.00004						
CNI		<0.00004	<0.00004	—	<0.00004	0.00006	0.00004
RMA		—	<0.0002	<0.0002	<0.0002	—	—
Silver	0.0001						
CNI		0.0001	<0.0001	—	0.0002	0.0001	<0.0006
RMA		—	<0.001	<0.0005	<0.0005	—	—
	Sample date—>	(2/13/91)	(2/12/91)	(2/13/91)	(2/12/91)	(2/12/91)	(2/14/91)
	Flow (cfs)—>	11.05	14.69	6.45	72.23	—	

Source: Noranda Minerals Corp. May 17, 1991. Data on file with the agencies.
§CCB = cross-contamination blank.
†*Labs:* CNI = Chen-Northern, Inc.
RMA = Rocky Mountain Analytical, Inc.

- Hydraulic conductivity (k) is calculated to be 0.0019 ft/min (0.014 gallon/ft/min) based on the geometric mean of seven hydraulic conductivity values measured in the LAD area (Noranda Minerals Corp., 1989h, Appendix A, Attachment 3).
- Gradient (i) is calculated to be 0.06 based on the ground water levels in the LAD area (Noranda Minerals Corp., 1992a, Figure S-1);
- saturated thickness of the aquifer is calculated to be 56 feet based on an average depth to bedrock of 76 feet and an average depth to water of 20 feet in six monitoring wells in the LAD area; and
- cross-sectional area (a) of the aquifer is calculated to be 302,400 ft^2 based on a total cross-sectional distance of 5,400 feet and a saturated thickness of 56 feet.

Water quality in the LAD area is shown in Table 3-18 of Chapter 3. Noranda used the August, 1991 sample results in its loading analysis. The agencies used the same results since those results are comparable to results from other monitoring well in the LAD area.

The agencies used Noranda's calculations for ground water flux in assessing ground water impacts. Noranda's assumptions may overestimate ground water flux and consequently underestimate projected changes in ground water quality.

Mine impact scenarios. Two water discharge scenarios were considered in the Alternative 1 loading analysis—one during mine construction (Year 3 of construction), during which adit and mine water would be discharged at the Ramsey Creek LAD area, and one during Year 18 (2nd post-operational year) when disposal of tailings water at the LAD would be at its maximum.

During the construction phase, ground water would enter the adits and be discharged at the LAD at an estimated total rate of 553 gpm (Year 3 of

construction). Noranda has estimated that adit inflows would be 392 gpm and mine inflows would be 8 gpm. For purposes of planning, Noranda added 153 gpm as a "safety factor" (Noranda Minerals Corp., May 17, 1991—on file with the agencies). Assuming that the safety factor water would be in similar proportions as the estimated mine and adit inflows, 542 gpm of adit water and 11 gpm of mine water is used in the loading analysis.

The inflow values developed by Noranda are point estimates; the agencies have reviewed the estimates and concurred that they are reasonable point estimates. However, as discussed in Chapters 2 and 4, actual mine and adit inflows would vary from the point estimates used in the loading analysis.

As discussed in Chapter 2, Noranda anticipates completing the Libby Creek adit in the first three months of the project. During this period, nitrogen concentrations in adit water are expected to be elevated due to blasting and all adit water from the Libby Creek adit (estimated maximum of 280 gpm) would be discharged to the Ramsey Creek LAD area.

After completion of the Libby Creek adit, work would begin to evaluate the orebody through exploratory drilling and construction of raises and laterals. During this period, inflows to the Libby Creek adit (post-construction adit water) would contain low nitrogen concentrations. Inflows from the active mining area (mine water) would be affected by blasting and would contain elevated nitrate levels. Both post-construction adit water (280 gpm) and mine water (11 gpm) would be discharged to the Ramsey Creek LAD area.

Noranda anticipates construction of Ramsey Creek adit to tie in with Libby Creek adit would begin about 6 months after project inception and take about 12 months. Noranda would construct the Ramsey Creek adit from both the surface at the Ramsey Creek portal, and underground with access from the Libby Creek adit decline. Inflows to the Libby Creek adit (post-construction adit water), inflows to the Ramsey Creek adit (construction adit water), and evaluation workings (mine water) would be discharged via the Libby Creek adit to the Ramsey Creek LAD area.

After the Ramsey Creek adit reaches the orebody, all Ramsey Creek adit (262 gpm) and mine inflows (11 gpm) would be discharged to the Ramsey Creek LAD sites via the Ramsey Creek adit. Inflows to Libby Creek adit (280 gpm) would continue to be discharged to the Ramsey Creek LAD area as long as nitrogen levels remained higher than ambient surface water concentrations.

During the first year of operation, placement of tailings in the tailings impoundment would have begun. Tailings water from the impoundment would seep through the tailings embankments and through the bottom of the impoundment. Seepage through the downstream embankment would be collected and pumped back into the tailings impoundment. Seepage through the downstream embankment, therefore, is not included in the loading analysis. Noranda estimates 6 gpm would seep through the diversion dam and south saddle dam by Year 16. The loading analysis includes 6 gpm in the Year 16 analysis.

Seepage from the bottom of the impoundment would enter shallow ground water which ultimately discharges to Libby Creek. The seepage rate was estimated using a one-dimensional seepage analysis and the Darcy Equation. A detailed discussion of this analysis is provided in the permit application (Morrison-Knudsen Engineers, Inc., 1989a). Seepage from the bottom of the tailings impoundment would increase over the project life, reaching a maximum seepage rate of 475 gpm in Year 16. Noranda estimates seepage may be less, based on additional geotechnical studies in the impoundment area. A portion of this seepage would be intercepted by the proposed pressure relief well system and returned to the impoundment. Noranda (1990) estimates that 97 gpm of this seepage would not be intercepted in Year 16 of operations.

Beginning in the first year after mining ceases (Year 17), seepages through the downstream embankment

and through the bottom of the impoundment would decrease. Noranda estimates that inflows into the impoundment would be 340 gpm more than outflows. Noranda would dispose of 206 gpm at the LAD area, and temporarily store 134 gpm in the impoundment. Maximum disposal of tailings water (207 gpm) is expected to occur in Year 18. Noranda estimates 93 gpm of tailings seepage would not be intercepted by the pressure relief/seepage interception system, resulting in a total of 280 of tailings water discharging to ground water in Year 18.

Estimated water quality—construction adit water. Discharges from the Libby Creek adit began in January, 1990. As a result of Noranda's monitoring, water quality data are available for inflows into and discharges from the adit. Inflow from the adit walls has been minimally affected by mining activities and should be similar to bedrock ground water quality (Table 6-10).

Table 6-10. Libby Creek adit inflow water quality.

Date sampled——> Parameter	Adit wall (3/28/90)	Adit wall (5/28/90)	Adit wall (6/11/90)	Adit wall (3/21/91)
	(mg/L)			
Total dissolved solids	119	100	119	102
pH (standard units)	7.8	7.7	7.5	8.0
Total hardness	96	81	102	55
Total alkalinity	112	111	104	81
Calcium	25	19	26	17
Magnesium	8	8	9	3
Sodium	10	22	11	23
Potassium	<1	<1	<1	0.2
Bicarbonate	123	135	127	99
Chloride	1	4	1	9
Sulfate	10	6	17	7
Ammonia	—	—	—	0.15
Nitrate/nitrite	0.10	<0.01	<0.01	0.3
Aluminum	<0.1	<0.1	<0.1	—
Arsenic	<0.005	<0.005	<0.005	<0.001
Cadmium	<0.001	<0.001	<0.001	—
Chromium	<0.02	<0.02	<0.02	—
Copper	<0.01	<0.01	<0.01	—
Iron	<0.05	<0.05	<0.05	—
Lead	<0.01	<0.01	<0.01	<0.0004
Manganese	0.06	0.03	0.05	—
Mercury	<0.0002	<0.0002	<0.0002	0.0001†
Molybdenum	<0.05	<0.05	<0.05	—
Silver	<0.001	<0.001	<0.001	<0.0001
Zinc	<0.02	<0.02	0.01	—

Source: Noranda Minerals Corp. Submitted to the agencies, March 27, 1991.
The 3/21/91 sample was analyzed using lower detection limits for selected metals.
†field blank had 0.00004 mg/L mercury.
Metal concentrations are dissolved.

Noranda collected 130 samples of adit water from the "A-2" settling pond prior to discharging the water to the Libby Creek adit percolation pond/land application area. Most of these samples were analyzed for nitrates plus nitrites as N (97 samples during adit construction); dissolved metals were analyzed less frequently (six samples). The samples analyzed for dissolved metals are shown in Table 6-11. Three samples were analyzed for total recoverable metals (Table 6-12). The DSL also has collected adit discharge water and analyzed them for total recoverable metals (Table 6-12). Total recoverable metal concentrations reflect metal contained in sediment or other filterable solids and are not used. They are presented for informational purposes only. Except for chromium, ammonia, and nitrate plus nitrite concentrations, expected adit water quality is based on the arithmetic mean of the six samples shown in Table 6-11.

Table 6-11. Quality of water of samples from the Libby Creek adit "A-2" settling pond (dissolved metals concentrations).

Date sampled——> Parameter	(3/26/90)	(6/27/90)	(8/22/90)	(4/16/91)	(7/22/91)	(9/16/91)
	(mg/L)					
Total dissolved solids	215	245	322	126	210	254
pH (standard units)	—	7.7	—	—	—	—
Total hardness	76	89	80	69	65	62
Total alkalinity	74	121	168	83	93	98
Calcium	22	24	22	19.6	19.6	18
Magnesium	5	7	6	4.7	3.9	4
Sodium	16	27	43	20.3	15.3	27
Potassium	13	7	29	3	6.4	23
Bicarbonate	60	148	55	101	113	119
Chloride	1	3	2	2	3	6
Sulfate	17	22	20	14	16	14
Ammonia	—	—	—	—	—	—
Nitrate/nitrite	32.1	47.4	46.9	5.44	20	28
Aluminum	0.1	1.4	<0.1	<0.1	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005	0.005	<0.005	<0.005
Cadmium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Chromium	0.02	0.03	<0.02	<0.02	<0.02	<0.02
Copper	<0.01	<0.01	<0.01	0.02	<0.02	<0.02
Iron	0.05	0.63	<0.05	<0.05	0.08	0.08
Lead	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01
Manganese	<0.02	0.05	<0.02	0.03	0.05	0.07
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Zinc	0.02	<0.02	<0.02	<0.02	0.05	0.05

Sources: Noranda Minerals Corp. 1992a.
Metal concentrations are dissolved.

In the supplemental petition information, Noranda used the geometric mean in calculating the expected adit water quality. The geometric mean is the appropriate statistical parameter to determine what would be a "typical" concentration of a randomly selected sample from a log-normally distributed population (Miesch, 1976). Most geochemical data, such as water quality parameters, are log-normally distributed. A geometric mean reduces the influence of outliers, or higher concentrations, on the mean of the sampled population. For example, the geometric mean of 20, 20, 30, 40 and 90 would be 33.7.

The arithmetic mean may be more appropriate for evaluating potential water quality effects from discharges. For example, the arithmetic mean of 20, 20, 30, 40 and 90 would be 40. Since outliers, or higher concentrations, have greater environmental effect, an arithmetic mean is more appropriate to determine the geochemical abundance or "average" concentration, regardless of the population distribu-

Table 6-12. Quality of water of samples from the Libby Creek adit "A-2" settling pond (total recoverable metals concentrations).

Date sampled——> Parameter	(4/10/90)	(4/10/91)†	(7/19/90)	(1/14/91) (mg/L)	(1/15/91)†	(6/19/91)†	(8/28/91)†
Total dissolved solids	241	—	142	—	—	204	126
pH (standard units)	10.3	10.9	—	—	—	9.1	8.3
Total hardness	109	—	58	—	—	—	—
Total alkalinity	99	—	61	—	—	49	86
Calcium	42	—	20	—	—	20	25
Magnesium	1	—	2	—	—	4	5
Sodium	12	—	14	—	—	19	19
Potassium	11	—	5	—	—	—	5
Bicarbonate	121	—	0	—	—	5	105
Chloride	1	—	3	—	—	4	9
Sulfate	29	—	4	—	—	—	15
Ammonia	—	6.3	7	9.5	10.4	—	—
Nitrate/nitrite	3.02	15.5	7.68	14.8	15.2	22.1	4.92
Aluminum	1.4	—	0.1	5.8	6.9	2.7	1.9
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005
Cadmium	0.0013	<0.001	<0.0001	0.0002	<0.001	<0.001	<0.001
Chromium	<0.02	—	<0.02	0.08	0.08	—	<0.02
Copper	0.007	<0.01	0.007	0.028	0.027	<0.01	<0.01
Iron	2.79	—	<0.02	12.4	14.9	—	—
Lead	0.013	<0.01	<0.001	0.09	0.09	0.03	<0.01
Manganese	0.06	0.05	<0.02	0.28	0.29	0.05	—
Mercury	<0.0002	—	0.0003	<0.0002	<0.0002	—	—
Molybdenum	<0.05	—	<0.05	0.05	<0.05	<0.005	—
Silver	0.0002	<0.005	0.0007	<0.0002	0.0002	<0.005	<0.005
Zinc	0.04	0.05	<0.01	0.08	0.09	0.11	0.03

Sources: Noranda Minerals Corp. 1992a.
†Department of State Lands. sampled on dates shown—on file with the DSL and the DHES.
Metal concentrations total recoverable.

tion (Miesch, 1976). An estimate of geochemical abundance is used "to judge the amount of the constituent that has been released to the environment... The geochemical abundance of a constituent in a population is equal to the population arithmetic mean." (Miesch, 1976).

Estimated water quality—nitrate concentrations in adit water. Nitrate plus nitrite as N (referred to as "nitrate") concentration in the 97 samples of Libby Creek adit water ranges from 2.3 mg/L to 309.5 mg/L, with most samples (90) with concentrations less than 100 mg/L. The geometric mean of nitrate concentration of the 97 samples, used by Noranda in the supplemental petition information to calculate projected water quality, is 23.5 mg/L; the arithmetic mean is 40.7 mg/L. To display a range of effects, both a "high range" of nitrate concentrations (the arithmetic mean) and a "low range nitrate concentrations (the geometric mean) was used in the agencies' analysis.

Noranda measured nitrate concentrations in samples from water quality monitoring stations upstream (LB 200) and downstream (LB 300) on a monthly basis prior to construction of Libby Creek adit (Table 6-13). Noranda also reported adit water discharges on a monthly basis. The agencies used this data to calculate nitrate concentrations of adit discharge (Table 6-13). A loading analysis similar to the analysis used for projected water quality was used. For the purpose of the nitrate analysis, nitrate concentrations were estimated using the following equation—

$$C_E = \frac{C_1Q_1 - C_2Q_2}{Q_3}$$

Where—

C_E is the estimated nitrate concentration of the adit discharge;

C_1 is the measured nitrate concentration at LB 300;

Q_1 is the measured streamflow at LB 300;

C_2 is the "ambient" nitrate concentration at LB 300 (the nitrate concentration at LB 200 during the same sampling period was used);

Q_2 is the "ambient" streamflow (the measured streamflow at LB 300 minus the adit discharge); and

Q_3 is the reported adit discharge

The analysis is based on these assumptions—

- discharged water instantaneously reaches Libby Creek;
- the reported discharged flows reach Libby Creek at the time of sampling;
- nitrate concentrations at LB 300 prior to discharges are the same as the nitrate concentrations at LB 200;
- no ammonia oxidizes to nitrate; and
- there is no plant uptake of nitrate.

The calculated nitrate concentration ranges from 24 mg/L in October 1991 to 205 mg/L in November, 1990. Highest concentrations at LB 300 occurred in October, 1991 (6.80 mg/L); lowest flow at LB 300 also occurred at that time. The lower calculated nitrate concentration since June, 1991 is close to the arithmetic mean of nitrate concentration (40.7 mg/L) used by the agencies as an estimate for high range of the nitrate concentration in Libby Creek adit water.

Chapter 4 discusses that ammonia and nitrate in adit and mine waters are the result of blasting, and ammonia and nitrate concentrations are proportional to the amount of blasting and inversely proportional to flow. Noranda estimates flows from the Ramsey Creek adits would be slightly less than from the Libby Creek adit because of the deeper depths of the Ramsey Creek adits. Noranda also assumes that nitrate and ammonia concentrations would be the same from both Ramsey adits as that of the Libby adit.

In the high range of nitrate and ammonia concentrations, the agencies used higher nitrate and ammonia concentrations to reflect the increased blasting necessary to construct the larger Ramsey Creek adits. It is unknown how much additional blasting would be required to construct the Ramsey Creek adits in comparison to the Libby Creek adit. Since there would be two Ramsey Creek adits, the agencies

Table 6-13. Calculated nitrate concentration of adit discharge.

Sample date	Measured nitrate concentration @ LB 300 (mg/L)	Libby Creek adit discharge (gpm)	Measured LB 300 flow (gpm)	"Ambient" LB 300 flow (gpm)	"Ambient" nitrate concentration @ LB 200 (mg/L)	Calculated nitrate concentration of discharge (mg/L)
Notes—>	1	2	3	4	5	
9/23/89	0.09	—	—	—	0.10	—
10/13/89	0.12	—	—	—	0.15	—
11/14/89	0.15	—	—	—	0.13	—
12/19/89	0.10	—	—	—	0.11	—
1/15/90	0.02	7	—	—	0.04	—
2/14/90	0.46	15	—	—	0.12	—
3/16/90	1.71	41	—	—	0.13	—
4/24/90	0.40	80	—	—	0.21	—
5/9/90	0.66	95	27,118	27,023	0.15	145.7
5/20/90	0.51	95	22,989	22,894	0.14	89.7
6/14/90	0.46	125	27,886	27,761	0.09	82.6
6/27/90	0.23	125	44,699	44,574	0.03	71.5
7/18/90	0.48	187	—	—	0.01	—
8/22/90	1.00	111	—	—	0.09	—
9/11/90	2.96	91	1,925	1,834	0.13	60.0
10/19/90	4.40	108	—	—	0.13	—
11/14/90	1.39	118	18,748	18,630	0.10	205.1
1/31/91	4.30	157	—	—	0.16	—
2/12/91	2.80	160	6,593	6,433	0.20	107.3
3/20/91	4.80	177	—	—	0.19	—
4/16/91	2.18	188	9,390	9,202	0.24	97.1
5/20/91	0.72	213	—	—	0.16	—
6/19/91	0.38	224	33,011	32,787	0.09	42.8
7/22/91	0.49	224	—	—	0.03	—
8/23/91	1.24	204	5,067	4,863	0.08	28.9
9/16/91	6.50	206	—	—	0.12	—
10/23/91	6.80	242	875	633	0.10	24.3
11/20/91	2.48	236	3,308	3,072	0.20	32.2
12/16/91	3.70	196	—	—	0.25	—

Sources and notes:
1 From Noranda's surface water quality database submitted to the DHES
2 From Noranda's 3/9/92 letter to the DSL
3 From Noranda's surface water quality database; cfs * 448.83 = gpm
4 Measured LB 300 flow minus adit discharge
5 Assumed LB 300 ambient nitrate concentration; from LB 200 measurements during same period.

estimate that nitrate and ammonia concentrations of the Ramsey Creek adits would be twice the nitrate and ammonia concentrations found in the Libby Creek adits. In the agencies' high range, nitrate concentration of Ramsey Creek adit water is estimated to be 81.4 mg/L, and 40.7 mg/L of Libby Creek adit water. It is not know what the nitrate concentration of adit water would be, and what the effect of increased blasting in the Ramsey Creek adits would be. To display a possible range of outcomes, in the agencies' low range, nitrate concentration of all adit water is estimated to be 23.5 mg/L.

Estimated water quality—post-construction adit water. Estimated post-construction adit water quality differs from estimated construction adit water quality in the concentrations of nitrates, nitrites and ammonia. After completing the Libby Creek adit, blasting in the adit would cease, and concentrations of nitrates, nitrites and ammonia would decrease. Estimated nitrate concentration in post-construction adit water is 1.04 mg/L based on the geometric mean of eight samples collected from Libby Creek adit water after blasting stopped on November 25, 1991. The arithmetic mean of these samples is essentially the same (1.06 mg/L) Analytical results for these samples are presented in Noranda's supplemental petition information (Noranda Minerals Corp., 1992a). Ammonia was not analyzed in any of the samples.

Estimated water quality—ammonia concentrations of adit water. Noranda estimates ammonia concentrations in construction adit water would be 4.66 mg/L and 0.52 mg/L in post-construction adit water. The 4.66 mg/L concentration is the geometric mean of three samples, and the 0.52 mg/L concentration is based on an assumption that ammonia concentrations in post-construction adit water would be half of the nitrate concentrations in post-construction adit water.

The agencies' analysis indicates Noranda's ammonia concentrations may be too low. Four samples of adit water have been analyzed for ammonia (Tables 6-11 and 6-12). Three of the samples have ammonia concentrations more than 65 percent of the nitrate concentrations and one sample has ammonia concentrations slightly less half the nitrate concentrations. Based on these sample results, it appears that four samples may not be adequate to characterize expected ammonia concentrations, and that the assumption that ammonia concentration is half of nitrate concentration may not be valid. In the agencies' high range, ammonia concentration of Ramsey Creek adit water is estimated to be 53.7 mg/L, and 26.9 mg/L of Libby Creek adit water. In the agencies' low range, nitrate concentration of all adit water is estimated to be 15.7 mg/L and 0.69 mg/L in post-construction adit water.

Estimated mine water quality. Estimated mine water quality is based on analysis of mine water discharged at ASARCO's Troy Mine (Table 6-14). Nitrate and ammonia concentrations were assumed to be equal to those expected for adit water. The Troy Mine is geologically similar to the proposed Montanore Project. The Troy Mine water quality provides the best available estimate of quality of the water that would be discharged during operations at the Montanore Project. Averaged values of four samples are used in the loading analysis. Estimated chromium concentration is assumed to be the same as the estimated chromium concentration of Libby Creek adit water. In general, Libby Creek adit water is similar to Troy Mine water. Chromium is not expected to be in higher concentrations in the ore zone of the Montanore deposit than in the adjacent unmineralized rock (see Tables 38-1 and 38-2 in Noranda's Permit Application, Noranda Minerals Corp., 1989a).

Dissolved water quality data from two samples shown in Table 6-14 are not included in the average. Both samples are from internal drainage system of the Troy Mine (D. Parker, Noranda Minerals Corp., pers. comm. w/ R. Trenholme, IMS, June 8, 1991). Sample DDH-101 is from an inactive portion of the mine; sample LQ drainhole is from an active portion of the mine. The concentrations of total dissolved solids and nitrates are considerably higher in the LQ drainhole sample than the other samples presented.

They are also higher than those found in Troy Mine tailings water quality (Table 6-14). The two drainhole samples and the sample with total recoverable metal concentrations are not used, and they are presented for informational purposes only.

Estimated tailings water quality. Estimated tailings water quality (Tables 6-15 and 6-16) is based on tailings water quality information from the Troy Mine. As with mine water, Troy Mine tailings water quality provides the best available estimate of expected tailings water quality. Estimated tailings water quality was calculated in the following manner—

- for parameters with all reported concentrations less than the reported detection limit (arsenic, chromium, mercury, and silver), the lowest detection limit value was used;
- for parameters having both detected concentrations and concentrations less than the reported detection limit (cadmium, copper, iron, lead, and zinc), the average of all detected concentrations, and the detection limit for all concentrations lower than detected concentrations were used;

Table 6-14. Troy Mine water quality.

	Samples used to calculate average				Expected	Troy Mine		Troy
	Troy Mine adit portal				mine	DDH-101	LQ Drainhole	adit portal
	12/10/87	12/16/87	12/17/87	12/18/87	water quality	12/10/87	12/10/87	12/10/87[†]
Parameter	(mg/L)							
pH	7.5	7.3	7.3	7.2	7.3	7.6	7.5	7.5
Total suspended solids	2,290	3,240	2,920	1,840	—	<1	144	2,290
Total dissolved solids	163	173	205	215	189	134	617	163
Total hardness	73	79	89	89	83	92	239	73
Calcium	22	24	26	26	—	26	73	—
Magnesium	4	5	6	6	—	7	14	—
Sodium	4	6	11	10	—	<1	48	—
Potassium	1	2	3	3	—	<1	10	—
Bicarbonate	63	68	66	63	—	46	119	—
Chloride	24	<1	<1	<1	—	<1	6	—
Sulfate	1	30	32	30	—	6	109	—
Ammonia	4.4	10.2	9.4	8.6		0.2	27.5	—
Nitrate/nitrite	7.6	22.78	18.95	19.94		<0.37	74.02	—
Aluminum	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6.9
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.027
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Chromium	—	—	—	—	<0.02	—	—	—
Copper	0.09	0.07	0.07	0.07	0.075	<0.01	0.28	30.9
Iron	—	—	—	—	<0.05	—	—	—
Lead	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.4
Manganese	0.33	0.42	0.55	0.38	0.42	<0.02	0.75	2.79
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum	—	—	—	—	<0.05	—	—	—
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011
Zinc	0.01	0.02	0.02	0.02	0.02	0.01	0.04	0.13

Source: ASARCO, Inc. 1987. p. 52a.
Metals concentrations are dissolved, except for [†] sample, which are total recoverable.

- nitrate and ammonia concentrations were assumed to be equal to those expected for adit water; and
- for all other parameters, the average concentration was used.

There is no one "best" way to determine an average concentration when reported concentrations are less than detection limit as well as when different detection limits are used for the same parameter. The method used by the agencies is the same method used by Noranda in the supplemental petition information. The method provides a reasonable estimate of tailings water quality.

Noranda conducted bench-scale testing of ore samples; these samples were subjected to simulated processing conditions. The "locked-cycle test results" sample also is representative of expected tailings water quality. Locked cycle testing is a bench scale metallurgic testing method for simulating the flotation process used in separating the concentrate from the tailings in the milling operation. The flotation process is simulated by adding reagents in the same pro-

Table 6-16. Tailings water quality with total recoverable metals concentrations.

Parameter	Rock Creek flotation test effluent¶	Troy Mine tailings water§ — average concentrations (geometric)*	(arithmetic)*	Number of samples — total	below detection limit†
	(mg/L)				
Total hardness	—	66	72	40	0
Total alkalinity	—	—	—	—	—
Calcium	11	17	18	53	0
Magnesium	3.1	5	6	53	0
Sodium	7.7	18	21	51	0
Potassium	15	21	31	55	0
Bicarbonate	—	73	80	49	0
Chloride	—	5	6	51	0
Sulfate	—	17.4	22.5	55	4
Ammonia	—	5.8	8.7	55	0
Nitrate/nitrite	—	13.8	15.8	56	0
Aluminum	0.55	—	—	—	—
Arsenic	0.001	—	—	—	—
Cadmium	0.0001	<0.0009	<0.0018	56	45
Chromium	0.033	—	—	—	—
Copper	0.2	<0.163	<1.189	64	1
Iron	0.13	0.934	2.299	56	0
Lead	0.012	<0.029	<0.100	64	9
Manganese	0.31	0.52	1.92	56	0
Mercury	—	—	—	—	—
Molybdenum	0.02	—	—	—	—
Silver	0.0004	<0.0019	<0.0041	58	45
Zinc	0.0001	<0.015	<0.076	60	6

Sources: ¶ASARCO. 1990. p. 20.
§Noranda Minerals Corp. April 23, 1991. Information collected from DSL and DHES files. Compiled data on file with the agencies.
*Detection limit values were used in calculating mean for samples with concentrations below detection limit.
†Detection limit varied by parameter.

portion that they would be used in the full scale operation. The flotation rougher and cleaner cells are simulated at a bench scale and the solutions and pulps are circulated or "cycled" a number of times to simulate the process flow of the full scale mill. This test is used to simulate the recovery of concentrate, the nature of the tailings and the chemical characteristics of the solutions generated in the flotation process. The samples of solution and tailings used to simulate the Montanore flotation circuit were subjected to five cycles in the test procedure prior to collecting the tailings and tailings solution.

Lower detection limit data are reported in Table 6-15. Arsenic, lead, and zinc were below detection limits in the lower detection limit sample. Mercury at a very low concentration was identified in one sample, but may have resulted from sample contamination. Total recoverable metal concentrations are reported in Table 6-16. Those results are not used in the loading analysis and are presented for informational purposes only.

Values used in the loading analysis are shown in Table 6-17. The results of the agencies' loading analysis for each discharge scenario are provided in Tables 6-18 through 6-33. Noranda's analysis, which differs from the agencies' analysis primarily in projected nitrate and ammonia concentrations, is presented in the supplemental petition information (Noranda Minerals Corp., 1992a).

The agencies' loading analysis, which is based upon the operations scenarios discussed previously, represents neither a "best case" nor a "worst case" analysis. Mine inflow and pumping rates, and tailings impoundment seepage rates may be greater or

Table 6-17. Values used in the agencies' loading analysis.

Parameter	Impact assessment location: RA 600	PM 1000	LB 2000	WDS-1	Tailings seepage	Construction adit water: Ramsey Creek	Libby Creek	Post-const. adit water	Mine water
	(mg/L)								
Total dissolved solids	<10.5	25	33	50	174	222	222	222	189
Total hardness	<6	<12	29	16	43	70	70	70	83
Total alkalinity	7	18	32	36	172	107	107	107	80
Ammonia (high r.)	<0.1	<0.05	<0.05	—	26.9	53.7	26.9	0.69	26.9
Ammonia (low r.)	<0.1	<0.05	<0.05	—	15.7	15.7	15.7	0.69	15.7
Nitrates (high r.)	0.07	0.04	0.03	0.16	40.7	81.4	40.7	1.04	40.7
Nitrates (low r.)	0.07	0.04	0.03	0.16	23.5	23.5	23.5	1.04	23.5
Aluminum	<0.1	<0.1	<0.1	<0.1	0.1	<0.3	<0.3	<0.3	<0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	<0.002	0.001	0.001	<0.02	<0.013	<0.015	<0.015	<0.015	0.075
Iron	<0.05	<0.05	<0.05	<0.05	<0.04	<0.16	<0.16	<0.16	<0.05
Lead	<0.001	<0.001	<0.001	<0.01	<0.0015	<0.01	<0.01	<0.01	<0.01
Manganese	<0.02	<0.02	<0.02	<0.02	0.45	<0.04	<0.04	<0.04	0.42
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0010	<0.0002	<0.0002	<0.0002	<0.001
Silver	<0.0002	<0.0003	0.0003	<0.001	<0.004	<0.001	<0.001	<0.001	<0.005
Zinc	<0.02	<0.02	<0.02	0.06	<0.02	<0.03	<0.03	<0.03	0.02

less than the rates used in this analysis. The actual quality of the adit water, mine water, and tailings pond water may be different (better or worse than expected). Therefore, the actual stream water quality changes observed during operations may be better or worse than these projections.

In addition to the scenarios identified above, the following assumptions have been made in the loading analysis—

- In the loading calculation, below detection limit values were assumed to equal the analytical detection limit.
- Since the seepage must reach surface water bodies following a ground water pathway, dissolved metal concentrations were used for the loading analysis.
- All disposal of excess water under Alternative 1 would occur at the Ramsey Creek land application disposal area; no other locations would be used for excess water disposal.
- The loading calculations do not include nitrate and ammonia contributions from waste rock affected by blasting.
- The loading analysis did not consider physical and chemical processes in the ground water system that may, at least temporarily, reduce the concentrations of some parameters.
- In performing the loading analysis, it was assumed that in-stream flows would not be reduced by surface water withdrawals or reduced by ground water inflows into the mine.
- Seepages from the seepage collection pond and the temporary water storage facility, expected to be small volumes, were not included in the loading analysis.
- The loading analysis is based upon steady state and average conditions. Short-term, high-rate inflows may temporarily occur as mine workings encounter and dewater saturated fractures. Seasonal variations in precipitation and evaporation, as well as the occurrence of wet years, might require the periodic disposal of excess tailings water in the land application disposal area.
- Seepage from the tailings pond and land application disposal area is assumed to reach the receiving stream instantaneously. Actual ground water travel times could be years to decades. Travel times for specific chemical constituents may be longer. However, hydrogeologic conditions at the tailings impoundment area may shorten the ground water flow path.

Fish and Other Aquatic Life

Projected water quality characteristics provided the basis for the assessment of impacts to fish and other aquatic life. Projected changes in streamflow, sediments, nutrients, and metals were evaluated and compared to reported effects in relevant literature (see Chapter 4, *Fish and Other Aquatic Life* section).

Soils

The primary impact to soils from transmission line construction probably would be increased erosion from the construction of access roads. Consequently, the analysis focused on disturbance associated with road building. The precise locations of structures and roads would be determined by a centerline survey. In comparing impacts of each alternative, several assumptions were made, as discussed below.

Structure locations. Noranda specified preliminary structure locations for the Miller Creek route and portions of the Swamp Creek route. DNRC and KNF staff made an educated guess at structure locations for the remaining portion of the Swamp Creek, mitigated Miller Creek, and North Miller Creek alternatives. Structure sites were first located along each route on ridge lines and at points where the line would change direction. Structure sites between these points were located at an assumed spacing of 750 feet. All structure locations were plotted on mylar overlays on USGS topographic maps at a scale of 1:24,000.

Table 6-18. Loading calculations for RA 600 during low flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (RA 600) Conc. (mg/L)	Flow (gpm)	Expected mine water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (RA 600) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	<10	628	189	9	222	217.5	222	232.5	<99	1,087
Ammonia (high)	<0.1	628	26.9	9	53.7	217.5	0.52	232.5	<11.1	1,087
Ammonia (low)	<0.1	628	15.7	9	15.7	217.5	0.52	232.5	<3.4	1,087
Nitrate (high)	0.07	628	40.7	9	81.4	217.5	1.04	232.5	16.9	1,087
Nitrate (low)	0.07	628	23.5	9	23.5	217.5	1.04	232.5	5.2	1,087
Aluminum	<0.1	628	<0.1	9	<0.3	217.5	<0.3	232.5	<0.2	1,087
Arsenic	<0.005	628	<0.005	9	<0.005	217.5	<0.005	232.5	<0.005	1,087
Cadmium	<0.0001	628	<0.001	9	<0.001	217.5	<0.001	232.5	<0.0005	1,087
Chromium	<0.02	628	<0.02	9	<0.02	217.5	<0.02	232.5	<0.020	1,087
Copper	<0.002	628	0.075	9	<0.015	217.5	<0.015	232.5	<0.008	1,087
Iron	<0.05	628	<0.05	9	<0.16	217.5	<0.16	232.5	<0.10	1,087
Lead	<0.001	628	<0.01	9	<0.01	217.5	<0.01	232.5	<0.005	1,087
Manganese	<0.02	628	0.42	9	<0.04	217.5	<0.04	232.5	<0.03	1,087
Mercury	<0.0002	628	<0.001	9	<0.0002	217.5	<0.0002	232.5	<0.0002	1,087
Silver	<0.0002	628	<0.005	9	<0.001	217.5	<0.001	232.5	<0.0006	1,087
Zinc	<0.02	628	0.02	9	<0.03	217.5	<0.03	232.5	<0.02	1,087

Source: Loading analysis by IMS Inc. 1992.

Table 6-19. Loading calculations for RA 600 during average flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (RA 600) Conc. (mg/L)	Flow (gpm)	Expected mine water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (RA 600) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	<10	8,932	189	9	222	217.5	222	232.5	<20	9,391
Ammonia (high)	<0.1	8,932	26.9	9	53.7	217.5	0.52	232.5	<1.38	9,391
Ammonia (low)	<0.1	8,932	15.7	9	15.7	217.5	0.52	232.5	<0.49	9,391
Nitrate (high)	0.07	8,932	40.7	9	81.4	217.5	1.04	232.5	2.02	9,391
Nitrate (low)	0.07	8,932	23.5	9	23.5	217.5	1.04	232.5	0.66	9,391
Aluminum	<0.1	8,932	<0.1	9	<0.3	217.5	<0.3	232.5	<0.1	9,391
Arsenic	<0.005	8,932	<0.005	9	<0.005	217.5	<0.005	232.5	<0.005	9,391
Cadmium	<0.0001	8,932	<0.001	9	<0.001	217.5	<0.001	232.5	<0.0001	9,391
Chromium	<0.02	8,932	<0.02	9	<0.02	217.5	<0.02	232.5	<0.020	9,391
Copper	<0.002	8,932	0.075	9	<0.015	217.5	<0.015	232.5	<0.003	9,391
Iron	<0.05	8,932	<0.05	9	<0.16	217.5	<0.16	232.5	<0.06	9,391
Lead	<0.001	8,932	<0.01	9	<0.01	217.5	<0.01	232.5	<0.001	9,391
Manganese	<0.02	8,932	0.42	9	<0.04	217.5	<0.04	232.5	<0.02	9,391
Mercury	<0.0002	8,932	<0.001	9	<0.0002	217.5	<0.0002	232.5	<0.0002	9,391
Silver	<0.0002	8,932	<0.005	9	<0.001	217.5	<0.001	232.5	<0.0002	9,391
Zinc	<0.02	8,932	0.02	9	<0.03	217.5	<0.03	232.5	<0.02	9,391

Source: Loading analysis by IMS Inc. 1992.

Table 6-20. Loading calculations for RA 600 during low flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (RA 600) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (RA 600) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	<10	628	174	172	222	0.0	222	0.0	<45	800
Ammonia (high)	<0.1	628	26.9	172	53.7	0.0	0.52	0.0	<5.9	800
Ammonia (low)	<0.1	628	15.7	172	15.7	0.0	0.52	0.0	<3.5	800
Nitrate (high)	0.07	628	40.7	172	81.4	0.0	1.04	0.0	8.8	800
Nitrate (low)	0.07	628	23.5	172	23.5	0.0	1.04	0.0	5.1	800
Aluminum	<0.1	628	0.1	172	<0.3	0.0	<0.3	0.0	<0.1	800
Arsenic	<0.005	628	<0.001	172	<0.005	0.0	<0.005	0.0	<0.004	800
Cadmium	<0.0001	628	<0.0001	172	<0.001	0.0	<0.001	0.0	<0.0001	800
Chromium	<0.02	628	<0.02	172	<0.02	0.0	<0.02	0.0	<0.020	800
Copper	<0.002	628	<0.013	172	<0.015	0.0	<0.015	0.0	<0.004	800
Iron	<0.05	628	<0.04	172	<0.16	0.0	<0.16	0.0	<0.05	800
Lead	<0.001	628	<0.0015	172	<0.01	0.0	<0.01	0.0	<0.001	800
Manganese	<0.02	628	0.45	172	<0.04	0.0	<0.04	0.0	<0.11	800
Mercury	<0.0002	628	<0.0002	172	<0.0002	0.0	<0.0002	0.0	<0.0002	800
Silver	<0.0002	628	<0.0001	172	<0.001	0.0	<0.001	0.0	<0.0002	800
Zinc	<0.02	628	<0.02	172	<0.03	0.0	<0.03	0.0	<0.02	800

Source: Loading analysis by IMS Inc. 1992.

Table 6-21. Loading calculations for RA 600 during average flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (RA 600) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (RA 600) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	<10	8,932	174	172	222	0.0	222	0.0	<13	9,104
Ammonia (high)	<0.1	8,932	26.9	172	53.7	0.0	0.52	0.0	<0.61	9,104
Ammonia (low)	<0.1	8,932	15.7	172	15.7	0.0	0.52	0.0	<0.40	9,104
Nitrate (high)	0.07	8,932	40.7	172	81.4	0.0	1.04	0.0	0.84	9,104
Nitrate (low)	0.07	8,932	23.5	172	23.5	0.0	1.04	0.0	0.51	9,104
Aluminum	<0.1	8,932	0.1	172	<0.3	0.0	<0.3	0.0	<0.1	9,104
Arsenic	<0.005	8,932	<0.001	172	<0.005	0.0	<0.005	0.0	<0.005	9,104
Cadmium	<0.0001	8,932	<0.0001	172	<0.001	0.0	<0.001	0.0	<0.0001	9,104
Chromium	<0.02	8,932	<0.02	172	<0.02	0.0	<0.02	0.0	<0.020	9,104
Copper	<0.002	8,932	<0.013	172	<0.015	0.0	<0.015	0.0	<0.002	9,104
Iron	<0.05	8,932	<0.04	172	<0.16	0.0	<0.16	0.0	<0.05	9,104
Lead	<0.001	8,932	<0.0015	172	<0.01	0.0	<0.01	0.0	<0.001	9,104
Manganese	<0.02	8,932	0.45	172	<0.04	0.0	<0.04	0.0	<0.03	9,104
Mercury	<0.0002	8,932	<0.0002	172	<0.0002	0.0	<0.0002	0.0	<0.0002	9,104
Silver	<0.0002	8,932	<0.0001	172	<0.001	0.0	<0.001	0.0	<0.0002	9,104
Zinc	<0.02	8,932	<0.02	172	<0.03	0.0	<0.03	0.0	<0.02	9,104

Source: Loading analysis by IMS Inc. 1992.

Table 6-22. Loading calculations for PM 1000 during low flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (PM 1000) Conc. (mg/L)	Flow (gpm)	Expected mine water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (PM 1000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	25	583	189	0.8	222	18.3	222	19.6	37	622
Ammonia (high)	<0.05	583	26.9	0.8	53.7	18.3	0.52	19.6	<1.7	622
Ammonia (low)	<0.05	583	15.7	0.8	15.7	18.3	0.52	19.6	<0.5	622
Nitrate (high)	0.04	583	40.7	0.8	81.4	18.3	1.04	19.6	2.5	622
Nitrate (low)	0.04	583	23.5	0.8	23.5	18.3	1.04	19.6	0.8	622
Aluminum	<0.1	583	<0.1	0.8	<0.3	18.3	<0.3	19.6	<0.1	622
Arsenic	<0.005	583	<0.005	0.8	<0.005	18.3	<0.005	19.6	<0.005	622
Cadmium	<0.0001	583	<0.001	0.8	<0.001	18.3	<0.001	19.6	<0.0002	622
Chromium	<0.02	583	<0.02	0.8	<0.02	18.3	<0.02	19.6	<0.020	622
Copper	0.001	583	0.075	0.8	<0.015	18.3	<0.015	19.6	<0.002	622
Iron	<0.05	583	<0.05	0.8	<0.16	18.3	<0.16	19.6	<0.06	622
Lead	<0.001	583	<0.01	0.8	<0.01	18.3	<0.01	19.6	<0.002	622
Manganese	<0.02	583	0.42	0.8	<0.04	18.3	<0.04	19.6	<0.02	622
Mercury	<0.0002	583	<0.001	0.8	<0.0002	18.3	<0.0002	19.6	<0.0002	622
Silver	<0.0003	583	<0.005	0.8	<0.001	18.3	<0.001	19.6	<0.0003	622
Zinc	<0.02	583	0.02	0.8	<0.03	18.3	<0.03	19.6	<0.02	622

Source: Loading analysis by IMS Inc. 1992.

Table 6-23. Loading calculations for PM 1000 during average flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (PM 1000) Conc. (mg/L)	Flow (gpm)	Expected mine water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (PM 1000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	25	7,989	189	0.8	222	18.3	222	19.6	26	8,028
Ammonia (high)	<0.05	7,989	26.9	0.8	53.7	18.3	0.52	19.6	<0.18	8,028
Ammonia (low)	<0.05	7,989	15.7	0.8	15.7	18.3	0.52	19.6	<0.09	8,028
Nitrate (high)	0.04	7,989	40.7	0.8	81.4	18.3	1.04	19.6	0.23	8,028
Nitrate (low)	0.04	7,989	23.5	0.8	23.5	18.3	1.04	19.6	0.10	8,028
Aluminum	<0.1	7,989	<0.1	0.8	<0.3	18.3	<0.3	19.6	<0.1	8,028
Arsenic	<0.005	7,989	<0.005	0.8	<0.005	18.3	<0.005	19.6	<0.005	8,028
Cadmium	<0.0001	7,989	<0.001	0.8	<0.001	18.3	<0.001	19.6	<0.0001	8,028
Chromium	<0.02	7,989	<0.02	0.8	<0.02	18.3	<0.02	19.6	<0.020	8,028
Copper	0.001	7,989	0.075	0.8	<0.015	18.3	<0.015	19.6	<0.001	8,028
Iron	<0.05	7,989	<0.05	0.8	<0.16	18.3	<0.16	19.6	<0.05	8,028
Lead	<0.001	7,989	<0.01	0.8	<0.01	18.3	<0.01	19.6	<0.001	8,028
Manganese	<0.02	7,989	0.42	0.8	<0.04	18.3	<0.04	19.6	<0.02	8,028
Mercury	<0.0002	7,989	<0.001	0.8	<0.0002	18.3	<0.0002	19.6	<0.0002	8,028
Silver	<0.0003	7,989	<0.005	0.8	<0.001	18.3	<0.001	19.6	<0.0003	8,028
Zinc	<0.02	7,989	0.02	0.8	<0.03	18.3	<0.03	19.6	<0.02	8,028

Source: Loading analysis by IMS Inc. 1992.

Table 6-24. Loading calculations for PM 1000 during low flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (PM 1000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (PM 1000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	25	583	174	14.5	222	0.0	222	0.0	29	598
Ammonia (high)	<0.05	583	26.9	14.5	53.7	0.0	0.52	0.0	<0.7	598
Ammonia (low)	<0.05	583	15.7	14.5	15.7	0.0	0.52	0.0	<0.4	598
Nitrate (high)	0.04	583	40.7	14.5	81.4	0.0	1.04	0.0	1.0	598
Nitrate (low)	0.04	583	23.5	14.5	23.5	0.0	1.04	0.0	0.6	598
Aluminum	<0.1	583	0.1	14.5	<0.3	0.0	<0.3	0.0	<0.1	598
Arsenic	<0.005	583	<0.001	14.5	<0.005	0.0	<0.005	0.0	<0.005	598
Cadmium	<0.0001	583	<0.0001	14.5	<0.001	0.0	<0.001	0.0	<0.0001	598
Chromium	<0.02	583	<0.02	14.5	<0.02	0.0	<0.02	0.0	<0.020	598
Copper	0.001	583	<0.013	14.5	<0.015	0.0	<0.015	0.0	<0.001	598
Iron	<0.05	583	<0.04	14.5	<0.16	0.0	<0.16	0.0	<0.05	598
Lead	<0.001	583	<0.0015	14.5	<0.01	0.0	<0.01	0.0	<0.001	598
Manganese	<0.02	583	0.45	14.5	<0.04	0.0	<0.04	0.0	<0.03	598
Mercury	<0.0002	583	<0.0002	14.5	<0.0002	0.0	<0.0002	0.0	<0.0002	598
Silver	<0.0003	583	<0.0001	14.5	<0.001	0.0	<0.001	0.0	<0.0003	598
Zinc	<0.02	583	<0.02	14.5	<0.03	0.0	<0.03	0.0	<0.02	598

Source: Loading analysis by IMS Inc. 1992.

Table 6-25. Loading calculations for PM 1000 during average flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (PM 1000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (PM 1000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	25	7,989	174	14.5	222	0.0	222	0.0	25	8,004
Ammonia (high)	<0.05	7,989	26.9	14.5	53.7	0.0	0.52	0.0	<0.10	8,004
Ammonia (low)	<0.05	7,989	15.7	14.5	15.7	0.0	0.52	0.0	<0.08	8,004
Nitrate (high)	0.04	7,989	40.7	14.5	81.4	0.0	1.04	0.0	0.11	8,004
Nitrate (low)	0.04	7,989	23.5	14.5	23.5	0.0	1.04	0.0	0.08	8,004
Aluminum	<0.1	7,989	0.1	14.5	<0.3	0.0	<0.3	0.0	<0.1	8,004
Arsenic	<0.005	7,989	<0.001	14.5	<0.005	0.0	<0.005	0.0	<0.005	8,004
Cadmium	<0.0001	7,989	<0.0001	14.5	<0.001	0.0	<0.001	0.0	<0.0001	8,004
Chromium	<0.02	7,989	<0.02	14.5	<0.02	0.0	<0.02	0.0	<0.020	8,004
Copper	0.001	7,989	<0.013	14.5	<0.015	0.0	<0.015	0.0	<0.001	8,004
Iron	<0.05	7,989	<0.04	14.5	<0.16	0.0	<0.16	0.0	<0.05	8,004
Lead	<0.001	7,989	<0.0015	14.5	<0.01	0.0	<0.01	0.0	<0.001	8,004
Manganese	<0.02	7,989	0.45	14.5	<0.04	0.0	<0.04	0.0	<0.02	8,004
Mercury	<0.0002	7,989	<0.0002	14.5	<0.0002	0.0	<0.0002	0.0	<0.0002	8,004
Silver	<0.0003	7,989	<0.0001	14.5	<0.001	0.0	<0.001	0.0	<0.0003	8,004
Zinc	<0.02	7,989	<0.02	14.5	<0.03	0.0	<0.03	0.0	<0.02	8,004

Source: Loading analysis by IMS Inc. 1992.

Table 6-26. Loading calculations for LB 2000 during low flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Existing conditions (LB 2000) Flow (gpm)	Expected mine water Conc. (mg/L)	Expected mine water Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Expected adit water (pre-construction) Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Expected adit water (post-construction) Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Projected conc. (LB 2000) Flow (gpm)
Total dissolved solids	33	3,905	189	11	222	262.0	222	280.0	56	4,458
Ammonia (high)	<0.05	3,905	26.9	11	53.7	262.0	0.52	280.0	<3.3	4,458
Ammonia (low)	<0.05	3,905	15.7	11	15.7	262.0	0.52	280.0	<1.0	4,458
Nitrate (high)	0.03	3,905	40.7	11	81.4	262.0	1.04	280.0	5.0	4,458
Nitrate (low)	0.03	3,905	23.5	11	23.5	262.0	1.04	280.0	1.5	4,458
Aluminum	<0.1	3,905	<0.1	11	<0.3	262.0	<0.3	280.0	<0.1	4,458
Arsenic	<0.005	3,905	<0.005	11	<0.005	262.0	<0.005	280.0	<0.005	4,458
Cadmium	<0.0001	3,905	<0.001	11	<0.001	262.0	<0.001	280.0	<0.0002	4,458
Chromium	<0.02	3,905	<0.02	11	<0.02	262.0	<0.02	280.0	<0.020	4,458
Copper	0.001	3,905	0.075	11	<0.015	262.0	<0.015	280.0	<0.003	4,458
Iron	<0.05	3,905	<0.05	11	<0.16	262.0	<0.16	280.0	<0.06	4,458
Lead	<0.001	3,905	<0.01	11	<0.01	262.0	<0.01	280.0	<0.002	4,458
Manganese	<0.02	3,905	0.42	11	<0.04	262.0	<0.04	280.0	<0.02	4,458
Mercury	<0.0002	3,905	<0.001	11	<0.0002	262.0	<0.0002	280.0	<0.0002	4,458
Silver	0.0003	3,905	<0.005	11	<0.001	262.0	<0.001	280.0	<0.0004	4,458
Zinc	<0.02	3,905	0.02	11	<0.03	262.0	<0.03	280.0	<0.02	4,458

Source: Loading analysis by IMS Inc. 1992.

Table 6-27. Loading calculations for LB 2000 during average flow conditions following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Existing conditions (LB 2000) Flow (gpm)	Expected mine water Conc. (mg/L)	Expected mine water Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Expected adit water (pre-construction) Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Expected adit water (post-construction) Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Projected conc. (LB 2000) Flow (gpm)
Total dissolved solids	33	54,578	189	11	222	262.0	222	280.0	35	55,131
Ammonia (high)	<0.05	54,578	26.9	11	53.7	262.0	0.52	280.0	0.31	55,131
Ammonia (low)	<0.05	54,578	15.7	11	15.7	262.0	0.52	280.0	0.13	55,131
Nitrate (high)	0.03	54,578	40.7	11	81.4	262.0	1.04	280.0	0.43	55,131
Nitrate (low)	0.03	54,578	23.5	11	23.5	262.0	1.04	280.0	0.15	55,131
Aluminum	<0.1	54,578	<0.1	11	<0.3	262.0	<0.3	280.0	<0.1	55,131
Arsenic	<0.005	54,578	<0.005	11	<0.005	262.0	<0.005	280.0	<0.005	55,131
Cadmium	<0.0001	54,578	<0.001	11	<0.001	262.0	<0.001	280.0	<0.0001	55,131
Chromium	<0.02	54,578	<0.02	11	<0.02	262.0	<0.02	280.0	<0.020	55,131
Copper	0.001	54,578	0.075	11	<0.015	262.0	<0.015	280.0	<0.001	55,131
Iron	<0.05	54,578	<0.05	11	<0.16	262.0	<0.16	280.0	<0.05	55,131
Lead	<0.001	54,578	<0.01	11	<0.01	262.0	<0.01	280.0	<0.001	55,131
Manganese	<0.02	54,578	0.42	11	<0.04	262.0	<0.04	280.0	<0.02	55,131
Mercury	<0.0002	54,578	<0.001	11	<0.0002	262.0	<0.0002	280.0	<0.0002	55,131
Silver	0.0003	54,578	<0.005	11	<0.001	262.0	<0.001	280.0	<0.0003	55,131
Zinc	<0.02	54,578	0.02	11	<0.03	262.0	<0.03	280.0	<0.02	55,131

Source: Loading analysis by IMS Inc. 1992.

Table 6-28. Loading calculations for LB 2000 during low flow conditions following discharge of adit water and with tailings seepage (Year 16 of operations).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	33	3,905	174	103	222	0.0	222	183.0	45	4,191
Ammonia (high)	<0.05	3,905	26.9	103	53.7	0.0	0.52	183.0	<0.7	4,191
Ammonia (low)	<0.05	3,905	15.7	103	15.7	0.0	0.52	183.0	<0.5	4,191
Nitrate (high)	0.03	3,905	40.7	103	81.4	0.0	1.04	183.0	1.1	4,191
Nitrate (low)	0.03	3,905	23.5	103	23.5	0.0	1.04	183.0	0.7	4,191
Aluminum	<0.1	3,905	0.1	103	<0.3	0.0	<0.3	183.0	0.1	4,191
Arsenic	<0.005	3,905	<0.001	103	<0.005	0.0	<0.005	183.0	<0.005	4,191
Cadmium	<0.0001	3,905	<0.0001	103	<0.001	0.0	<0.001	183.0	<0.0001	4,191
Chromium	<0.02	3,905	<0.02	103	<0.02	0.0	<0.02	183.0	<0.020	4,191
Copper	0.001	3,905	<0.013	103	<0.015	0.0	<0.015	183.0	<0.002	4,191
Iron	<0.05	3,905	<0.04	103	<0.16	0.0	<0.16	183.0	<0.05	4,191
Lead	<0.001	3,905	<0.0015	103	<0.01	0.0	<0.01	183.0	<0.0014	4,191
Manganese	<0.02	3,905	0.45	103	<0.04	0.0	<0.04	183.0	<0.03	4,191
Mercury	<0.0002	3,905	<0.0002	103	<0.0002	0.0	<0.0002	183.0	<0.0002	4,191
Silver	0.0003	3,905	<0.0001	103	<0.001	0.0	<0.001	183.0	<0.0003	4,191
Zinc	<0.02	3,905	<0.02	103	<0.03	0.0	<0.03	183.0	<0.02	4,191

Source: Loading analysis by IMS Inc. 1992.

Table 6-29. Loading calculations for LB 2000 during average flow conditions following discharge of adit water and with tailings seepage (Year 16 of operations).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	33	54,578	174	103	222	0.0	222	183.0	34	54,864
Ammonia (high)	<0.05	54,578	26.9	103	53.7	0.0	0.52	183.0	0.10	54,864
Ammonia (low)	<0.05	54,578	15.7	103	15.7	0.0	0.52	183.0	0.08	54,864
Nitrate (high)	0.03	54,578	40.7	103	81.4	0.0	1.04	183.0	0.11	54,864
Nitrate (low)	0.03	54,578	23.5	103	23.5	0.0	1.04	183.0	0.08	54,864
Aluminum	<0.1	54,578	0.1	103	<0.3	0.0	<0.3	183.0	0.1	54,864
Arsenic	<0.005	54,578	<0.001	103	<0.005	0.0	<0.005	183.0	<0.005	54,864
Cadmium	<0.0001	54,578	<0.0001	103	<0.001	0.0	<0.001	183.0	<0.0001	54,864
Chromium	<0.02	54,578	<0.02	103	<0.02	0.0	<0.02	183.0	<0.020	54,864
Copper	0.001	54,578	<0.013	103	<0.015	0.0	<0.015	183.0	<0.001	54,864
Iron	<0.05	54,578	<0.04	103	<0.16	0.0	<0.16	183.0	<0.05	54,864
Lead	<0.001	54,578	<0.0015	103	<0.01	0.0	<0.01	183.0	<0.0010	54,864
Manganese	<0.02	54,578	0.45	103	<0.04	0.0	<0.04	183.0	<0.02	54,864
Mercury	<0.0002	54,578	<0.0002	103	<0.0002	0.0	<0.0002	183.0	<0.0002	54,864
Silver	0.0003	54,578	<0.0001	103	<0.001	0.0	<0.001	183.0	<0.0003	54,864
Zinc	<0.02	54,578	<0.02	103	<0.03	0.0	<0.03	183.0	<0.02	54,864

Source: Loading analysis by IMS Inc. 1992.

Table 6-30. Loading calculations for LB 2000 during low flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	33	3,905	174	286	222	0.0	222	0.0	43	4,191
Ammonia (high)	<0.05	3,905	26.9	286	53.7	0.0	0.52	0.0	<1.9	4,191
Ammonia (low)	<0.05	3,905	15.7	286	15.7	0.0	0.52	0.0	<1.1	4,191
Nitrate (high)	0.03	3,905	40.7	286	81.4	0.0	1.04	0.0	2.8	4,191
Nitrate (low)	0.03	3,905	23.5	286	23.5	0.0	1.04	0.0	1.6	4,191
Aluminum	<0.1	3,905	0.1	286	<0.3	0.0	<0.3	0.0	0.1	4,191
Arsenic	<0.005	3,905	<0.001	286	<0.005	0.0	<0.005	0.0	<0.005	4,191
Cadmium	<0.0001	3,905	<0.0001	286	<0.001	0.0	<0.001	0.0	<0.0001	4,191
Chromium	<0.02	3,905	<0.02	286	<0.02	0.0	<0.02	0.0	<0.020	4,191
Copper	0.001	3,905	<0.013	286	<0.015	0.0	<0.015	0.0	<0.002	4,191
Iron	<0.05	3,905	<0.04	286	<0.16	0.0	<0.16	0.0	<0.05	4,191
Lead	<0.001	3,905	<0.0015	286	<0.01	0.0	<0.01	0.0	<0.0010	4,191
Manganese	<0.02	3,905	0.45	286	<0.04	0.0	<0.04	0.0	<0.05	4,191
Mercury	<0.0002	3,905	<0.0002	286	<0.0002	0.0	<0.0002	0.0	<0.0002	4,191
Silver	0.0003	3,905	<0.0001	286	<0.001	0.0	<0.001	0.0	<0.0003	4,191
Zinc	<0.02	3,905	<0.02	286	<0.03	0.0	<0.03	0.0	<0.02	4,191

Source: Loading analysis by IMS Inc. 1992.

Table 6-31. Loading calculations for LB 2000 during average flow conditions following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (LB 2000) Conc. (mg/L)	Flow (gpm)	Expected tailings water Conc. (mg/L)	Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Flow (gpm)	Projected conc. (LB 2000) Conc. (mg/L)	Flow (gpm)
Total dissolved solids	33	54,578	174	286	222	0.0	222	0.0	34	54,864
Ammonia (high)	<0.05	54,578	26.9	286	53.7	0.0	0.52	0.0	0.19	54,864
Ammonia (low)	<0.05	54,578	15.7	286	15.7	0.0	0.52	0.0	0.13	54,864
Nitrate (high)	0.03	54,578	40.7	286	81.4	0.0	1.04	0.0	0.24	54,864
Nitrate (low)	0.03	54,578	23.5	286	23.5	0.0	1.04	0.0	0.15	54,864
Aluminum	<0.1	54,578	0.1	286	<0.3	0.0	<0.3	0.0	0.1	54,864
Arsenic	<0.005	54,578	<0.001	286	<0.005	0.0	<0.005	0.0	<0.005	54,864
Cadmium	<0.0001	54,578	<0.0001	286	<0.001	0.0	<0.001	0.0	<0.0001	54,864
Chromium	<0.02	54,578	<0.02	286	<0.02	0.0	<0.02	0.0	<0.020	54,864
Copper	0.001	54,578	<0.013	286	<0.015	0.0	<0.015	0.0	<0.001	54,864
Iron	<0.05	54,578	<0.04	286	<0.16	0.0	<0.16	0.0	<0.05	54,864
Lead	<0.001	54,578	<0.0015	286	<0.01	0.0	<0.01	0.0	<0.0010	54,864
Manganese	<0.02	54,578	0.45	286	<0.04	0.0	<0.04	0.0	<0.02	54,864
Mercury	<0.0002	54,578	<0.0002	286	<0.0002	0.0	<0.0002	0.0	<0.0002	54,864
Silver	0.0003	54,578	<0.0001	286	<0.001	0.0	<0.001	0.0	<0.0003	54,864
Zinc	<0.02	54,578	<0.02	286	<0.03	0.0	<0.03	0.0	<0.02	54,864

Source: Loading analysis by IMS Inc. 1992.

Table 6-32. Loading calculations for WDS-1 following discharge of adit and mine water (Year 3 of construction).

Parameter	Existing conditions (WDS-1) Conc. (mg/L)	Existing conditions (WDS-1) Flow (gpm)	Expected mine water Conc. (mg/L)	Expected mine water Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Expected adit water (pre-construction) Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Expected adit water (post-construction) Flow (gpm)	Projected conc. (WDS-1) Conc. (mg/L)	Projected conc. (WDS-1) Flow (gpm)
Total dissolved solids	50	254	211	11	222	262	222	280	168	807
Nitrate (high)	0.16	254	40.7	11	81.4	262	1.04	280	27.39	807
Nitrate (low)	0.16	254	23.5	11	23.5	262	1.04	280	8.4	807
Aluminum	<0.1	254	<0.1	11	<0.3	262	<0.3	280	<0.2	807
Arsenic	<0.005	254	<0.005	11	<0.005	262	<0.005	280	<0.005	807
Cadmium	<0.001	254	<0.001	11	<0.001	262	<0.001	280	<0.0010	807
Chromium	<0.02	254	0.007	11	<0.02	262	<0.02	280	<0.020	807
Copper	<0.02	254	0.075	11	<0.015	262	<0.015	280	<0.020	807
Iron	<0.05	254	<0.05	11	<0.16	262	<0.16	280	<0.13	807
Lead	<0.01	254	<0.01	11	<0.01	262	<0.01	280	<0.010	807
Manganese	<0.02	254	0.42	11	<0.04	262	<0.04	280	<0.04	807
Mercury	<0.0002	254	<0.001	11	<0.0002	262	<0.0002	280	<0.0002	807
Silver	<0.001	254	<0.005	11	<0.001	262	<0.001	280	<0.0011	807
Zinc	0.06	254	0.02	11	<0.03	262	<0.03	280	<0.06	807

Source: Loading analysis by IMS Inc. 1992.

Table 6-33. Loading calculations for WDS-1 following discharge of tailings water and tailings seepage (Year 18 of operations).

Parameter	Existing conditions (WDS-1) Conc. (mg/L)	Existing conditions (WDS-1) Flow (gpm)	Expected tailings water Conc. (mg/L)	Expected tailings water Flow (gpm)	Expected adit water (pre-construction) Conc. (mg/L)	Expected adit water (pre-construction) Flow (gpm)	Expected adit water (post-construction) Conc. (mg/L)	Expected adit water (post-construction) Flow (gpm)	Projected conc. (WDS-1) Conc. (mg/L)	Projected conc. (WDS-1) Flow (gpm)
Total dissolved solids	50	254	174	207	222	0	222	0	106	461
Nitrate (high)	0.16	254	40.7	207	81.4	0	1.04	0	18.4	461
Nitrate (low)	0.16	254	23.5	207	23.5	0	1.04	0	10.64	461
Aluminum	<0.1	254	0.1	207	<0.3	0	<0.3	0	<0.1	461
Arsenic	<0.005	254	<0.001	207	<0.005	0	<0.005	0	<0.005	461
Cadmium	<0.001	254	<0.0010	207	<0.001	0	<0.001	0	<0.0010	461
Chromium	<0.02	254	<0.02	207	<0.02	0	<0.02	0	<0.020	461
Copper	<0.02	254	<0.013	207	<0.015	0	<0.015	0	<0.020	461
Iron	<0.05	254	<0.04	207	<0.16	0	<0.16	0	<0.05	461
Lead	<0.01	254	<0.0015	207	<0.01	0	<0.01	0	<0.010	461
Manganese	<0.02	254	0.45	207	<0.04	0	<0.04	0	<0.21	461
Mercury	<0.0002	254	<0.0002	207	<0.0002	0	<0.0002	0	<0.0002	461
Silver	<0.001	254	<0.0001	207	<0.001	0	<0.001	0	<0.0010	461
Zinc	0.06	254	<0.02	207	<0.03	0	<0.03	0	<0.06	461

Source: Loading analysis by IMS Inc. 1992.

Access road and trail locations. Existing area roads were drawn on mylar overlays to the USGS topographic maps using information from Noranda, the KNF, and aerial photos. For structure locations not immediately adjacent to an existing road, a preliminary access road location was identified, assuming a road grade less than 12 percent would be required for line construction equipment. Road locations were reviewed and revised where necessary by the KNF personnel to help ensure the roads were suitably located (D. Erwin, KNF Engineer, pers. comm. w/ Tom Ring, DNRC, January 8, 1990). It was assumed that no access road construction would occur on slopes less than 10 percent, since construction vehicles can reach structure sites after on 10 percent slopes or less.

Where sideslopes greater than 10 percent were encountered (E. Netherton, Redpath Engineers, Inc., pers. comm. w/ Tom Ring, DNRC, October 17, 1989), a low standard or primitive road was assumed to provide access for the stringing bulldozer. The need for this primitive access road was assumed along the Miller Creek route where sideslopes greater than 10 percent would be encountered. No access road construction was assumed where the stringing tractor would operate directly up or down a slope. Use of a helicopter to string the conductors was assumed under Alternatives 4, 5 and 6, eliminating the need for primitive roads along the line in steep terrain.

Impacts were estimated assuming mitigating measures proposed by Noranda or the agencies would be implemented. Slope maps (Noranda Minerals Corp., 1989c) and 1:24,000 USGS topographic maps were used to assign slope categories along each alternative. Land type maps (Noranda Minerals Corp., 1989c; Kuenan and Gerhardt, 1984) were used to determine highly erodible soils crossed by each alternative and associated access roads.

Vegetation

A USGS 1:24,000 topographic base map of the proposed routes was used to hand calculate vegetation impact for the transmission line alternatives. The overlay for clearcuts was compiled from USGS orthophoto quads and KNF land use maps. The overlay for old growth areas was produced by the KNF, with survey data in part by Noranda. All inventoried old growth habitat was assessed for impact from transmission line construction.

Right-of-way clearing is expected to remove trees in a 100-foot wide strip in most forested areas. Tall trees outside the right-of-way may still fall within the conductor arc swing, and require selective removal to ensure safe operation of the line. Data presented for right-of-way clearing assume the 100-foot wide strip with no correction for tree cutting outside the right-of-way. This “fringed border” is favorable for species that colonize edge habitats, but reduces core area. In areas of old growth habitat, a 200-foot wide strip is assumed for clearing the right-of-way. Old growth trees are often much taller than other mature forest stands, so a 200-foot wide clearance was assumed to ensure trees will not fall on the conductor.

Ground disturbance occurs where roads are built, at pole locations, at pulling sites for conductor stringing, and at storage sites. Disturbance for roads is affected by soil erosiveness and the slope of the terrain. A weighted average potential for soil erosiveness was calculated for each alternative based on land types. Slopes were grouped into four categories. Ground disturbance for roads was measured on the basis of this weighted average and the total length of roads in each slope category. Road width was assumed to be 12 feet, with a 10 percent allowance for pull outs.

Wildlife

The tool used for assessment of grizzly bear impacts was a Cumulative Effects Model. Additional studies were conducted by the KNF, the USFWS, and Noranda. Available literature was reviewed and specialists in various state and federal agencies were contacted. Details of the model are described in the *Cumulative Effects Analysis Process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems* (U.S. Forest Service, 1988). The CEM analyses the effects of various activities on bear management units (BMUs) which have been established within the CYE to assist in addressing cumulative effects on the grizzly bear and its habitat. Information on the CEM is on file at the KNF.

Land Use

General background. Information on current and proposed land uses was gathered from the Noranda applications and maps, the KNF Forest Plan, Kootenai timber sale plans and maps, Special Use Permits, Mineral Material Permits, Plans of Operations, 1984 and 1987 aerial photos, and on-the-ground mapping by DNRC staff.

The KNF Forest Plan (Kootenai National Forest, 1987) identifies how mineral development, roads, and powerline corridors would be designated and managed in different areas of the forest (Vol. 1) and (Vol. 2, Appendix 15, Corridor Criteria). All existing powerlines crossing the forest now are designated and managed under the standards of Management Area 23—Electric Transmission Corridor. Future transmission line corridors are to be designated, using the Forest Plan Appendix 15 criteria. New transmission lines, such as for the Montanore Project, would be approved according to criteria used to manage resources in the areas to be crossed and the standards of Management Area 23—Electric Transmission Corridor.

The Forest Plan identifies areas to be avoided for transmission line siting as "land areas that pose particular land use or environmental impacts that would be difficult or impossible to mitigate (may vary by type of facility)" (Appendix 15). Corridor avoidance areas include developed and primitive recreation areas, research natural areas, certain wildlife habitat areas, steep land, wetlands and slump areas, historical sites, areas with stringent visual objectives, wild, scenic and recreational rivers, nationally classified trails, and state recreation areas. These areas are identified on the Forest Plan Management Area maps. In its analysis, the DNRC totalled the miles of each Management Area crossed by each of the alternative routes and determined whether the management direction for each provided for activities such as logging and crossing by a powerline.

Analysis methods. The DNRC used air photos, Kootenai timber sale maps, and the Noranda application maps (Noranda Minerals Corp., 1989c and 1989d) in its analysis. Areas of past logging or logging that will be completed by 1991 were indicated on a land use map. This map includes roads useable by logging trucks. Necessary new roads were mapped by the DNRC (see Soils). An overlay of the Forest Plan Management Areas was used to determine miles of each area crossed by the line and miles of new roads across each area. Management Areas were placed in one of two categories. The first category included areas where logging was permitted. The other category included areas where recreation or protection of natural features were emphasized over logging. Acres of disturbance along each route were calculated for non-logged lands, using an average of 12.2 acres of forest clearing per mile of powerline, 3 acres of clearing per mile of road construction (varies widely depending on slope), 0.2 acre of clearing per pulling site, and 1 acre of clearing for a storage area for each route. The individual disturbance estimates were then totalled to get a total disturbance estimate. Individual pole disturbances of 0.002 acre per pole were included within the forest clearing estimates.

The miles of unplowed winter access were estimated by using maps to calculate areas that would be more than 0.25 mile from a plowed road and at elevations above 3,500 feet, where end-of-season snow accumulations of two feet or more were assumed to occur.

The estimated timber volumes that would be removed for clearing the powerline right-of-way, stringing sites, and access roads were derived from nearby sales information where the volume to be removed is expected to be about 20,000 board feet per acre, except in regrown burned areas where 10,000 board feet per acre would be removed.

Visual Resources

An inventory of visual resources was compiled from existing data available from the KNF. The visual resource inventory conducted by the KNF during a forest-wide planning process is known as the Visual Management System (VMS). The VMS included inventories of variety classes, areas of viewing significance, Visual Quality Objectives, and Visual Absorption Capability.

Viewing significance classifies areas of visual quality; viewing significance is defined in the *Glossary*. Visual analysis typically classifies views into foreground (up to 0.5 mile), middleground (0.5 to 3 miles), and distant or background views (over 3 miles). The dominance of visual changes to the landscape generally depends on how close the viewer is to the changes. View duration is also an important consideration. Mountain peaks and campgrounds will typically have a longer view duration than primary travel routes.

KNF's objectives for the visual management of the land are expressed as Visual Quality Objectives (VQO) in the Forest Plan and indicate a management decision in the Forest Plan EIS to manage areas of land within the defined standard. The "preservation" VQO prohibits any modification to the landscape, whereas "maximum modification" allows development to dominate over the characteristic landscape, if necessary. "Retention," "partial retention" and "modification" are VQOs that cover the range between these extremes.

Visual impact of the proposed transmission centerlines was assessed for viewpoints along the U.S. 2 corridor, Forest Service roads and trails, recreation areas, and the Cabinet Mountains wilderness. These viewpoints were used to analyze and assess visual impact on both Forest Service and private land.

Information developed for the Forest Service Visual Management System and the KNF Forest Plan—viewing significance, distance zones, and visual quality objectives--helped assess visual impact on Forest Service land. Information developed by Noranda—computer visibility maps, 3-dimensional computer simulations, and levels of visual absorptive capability of the landscape—also was used. In general, higher levels of visual impact would occur where land with high visibility, more stringent visual quality objectives, high viewing significance, and low absorptive capability would be crossed by the line.

The use of the VMS system and its principles to evaluate project impacts and alternatives is only analytical and comparative in nature. High impacts or failure to meet the Visual Quality Objective does not preclude project actions or alternatives. Visual impacts must be weighed with other resources. On KNF lands, the standard to be met or specifically waived by the Forest Service decision based on this EIS is the VQO by Management Areas contained in the Forest Plan.

Traffic

Methods described in the *Highway Capacity Manual, Special Report No. 209* were used to assess the proposed project's impact on traffic congestion. A Service Flow Rate, which is the maximum hourly traffic volume a roadway can support for a given level of service, for level of service "C" was used. Both morning and afternoon peak traffic periods

were analyzed. The following assumptions were made regarding U.S. 2—

- directional distribution of traffic 50 percent in each direction;
- 20 percent traffic allows for no passing;
- a 0.70 adjustment factor for narrow lanes and restricted shoulder width;
- daily traffic volume 2,650 in 1988 and 3,265 in 2008;
- traffic volumes decrease 25 percent between USFS Rd. 278/U.S. 2 and Libby; and
- a 13 percent percent peak hour factor (based on discussions with the Montana Department of Highways).

The following assumptions were made regarding USFS Rd. 278—

- 12-foot traffic lanes, 3-foot shoulder;
- 50 percent no passing in mountainous terrain;
- no severe grades;
- base yearly traffic of 90 vehicles; and
- an annual traffic growth rate of 2 percent, which resulted in a traffic volume of 135 in the year 2008.

The analysis of the U.S. 2/USFS Rd. 278 intersection was conducted for 1992 and for the year 2008. Within each year, both morning and afternoon peak traffic periods were analyzed. The analysis assumed that the intersection was unsignalized.

For Alternative 2, a 50 percent increase in carpooling or ride sharing and mass transit would result in an automobile occupancy rate 1.75. For the day shift, there would be 203 people traveling to the proposed project. The assumption was made that 103 would use mass transit (three buses) and the remaining 100 employees would travel in 57 vehicles. This would result in 60 total vehicle trips—a reduction of 75 vehicle trips. For the swing shift and graveyard shift, 83 vehicle trips would amount to 125 person-trips. The assumption was made that 65 would use mass transit (two buses). The remaining 60 employees would travel in 34 vehicles.

Safety. The change in vehicle miles of travel (VMT) was used as the surrogate for safety. The total accident rate on US 2 near Libby is 1.45 accidents per million VMT (MVMT), and the severe accident rate is 1.41 accidents per MVMT.

Load carrying capacity. The use of equivalent system application loading (ESAL) was used as the measure of the impact to the load carrying capacity of US 2. ESALs were calculated for a 10-year period using the following vehicle mix: passenger cars and pickups, 3 per 1,000 application; single unit trucks, 249 per 1,000 application; combination trucks, 1,087 per 1,000 application.

Cumulative impacts. Using the information on proposed and current timber sales in Chapter 2, a worst case assumption was made that proposed timber sales would result in an additional 15 truck trips per day, or four additional truck trips during peak traffic periods. It was also assumed that all additional truck trips would use USFS Rd. 278.

Socioeconomics

Methods used to collect and analyze baseline socioeconomic data included—

- review of permit application materials;
- discussions with citizens and local officials;
- review of published data by local, state, and federal agencies;
- review of materials being collected by Noranda and its consultants for the Hard Rock Mining Impact Plan; and
- review of information collected during the EIS scoping process.

Date collected were the most currently available as of late 1988; more recent data were provided only where the new data were fundamentally different than 1988 data. Data from the pst also were collected to analyze trends. Surveys, questionnaires and additional primary data gathering efforts were not performed.

Baseline data were combined with project-related data (employment needs and schedule, access to facilities, etc.) to estimate impacts due to proposed project development within each specific impacted

jurisdiction. The basis for the methodology used to estimate impacts is the economic base concept, whereby each new basic job generates indirect (or service) employment. In-migrating basic and non-basic employment, plus dependents associated with this employment, were allocated to specific residency areas. Comparison of the population increase to baseline population forms the basis for analysis of the significance of impacts. Once population effects were estimated, effects on community services, facilities, housing and quality of life were determined.

The analysis required the formulation of several assumptions. These are discussed in Chapter 4 where appropriate. Assumptions were determined through review of available data on similar projects and through discussion with local informed parties.

Noise

The STAMINA 2.0 program was used to model traffic noise. The original highway noise prediction computer program was developed under contract to the U.S. Department of Transportation, and published in 1972. The Transportation Systems Center made a few modifications to the program and published a user's manual. After this, the program became one of the Federal Highway Administration's approved traffic noise prediction methods, and the program became known popularly as the "TSC Method" of traffic noise prediction.

The STAMINA 2.0 program performs all of the highway traffic noise prediction. The basic problem considered in the STAMINA code is the estimation of the acoustic intensity at a receiver location resulting from noise generated by traffic on roads. The source characteristics are defined by speed-dependent reference noise emission levels and vehicle density by vehicle type. The geometry is three dimensional. The program considers characteristics of the source-receiver path by including the effects of intervening barriers, topography, trees, and atmospheric absorption.

The calculations of the noise levels along Bear Creek Road and U.S. 2 assumed that there were no topographical barriers between the vehicle and the receivers that would reduce the noise levels. Also, the program included the effect of sound absorption by grass, shrubs and trees between the vehicles and the receivers.

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EIS PREPARERS

The following people were involved in the research, writing and review of this FEIS—

Team Leaders

Bob Thompson–KNF, Projects Coordinator
Darcy Pederson–KNF, Libby District Ranger
Alicia Stickney–DSL, Hard Rock Bureau
Sandi Olsen–DSL, Hard Rock Bureau Chief
Kevin Hart–DNRC, Projects Coordinator
Abe Horpestad–DHES, Environmental Program Supervisor
Richard Trenholme–IMS, Inc., Project Manager

Air Quality

Ron Russell–USFS-RO
Anne Acheson–USFS-RO
Pat Driscoll–DSL
Kevin Hart–DNRC, Projects Coordinator
Warner Reeser–Harding Lawson Associates, Inc.

Geology/Geotechnical

Robert Thompson–KNF
Craig Pagel–DSL
Tom Ring–DNRC
Nick La Fronz–Sergent, Hauskins, & Beckwith, Inc.
Jerry Zimpfer–Harding Lawson Associates, Inc.
Landy Stinnett–Pincock, Allen, and Holt, Inc.
Joe Agapito—J.F.T Agapito & Associates, Inc.
Archie Richardson—J.F.T Agapito & Associates, Inc.

Hydrology

Steve Johnson–KNF
Bob Thompson–KNF
Abe Horpestad–DHES
Tom Ring–DNRC
Jerry Zimpfer–Harding Lawson Associates, Inc.
Jim Mavis—CH_2M Hill, Inc.
Bill Bluck—CH_2M Hill, Inc.

Aquatics and Fisheries

Doug Perkinson–KNF
Larry Brown–DHES
Mike Marcus–Western Aquatics, Inc.

Wetlands

Bob Thompson–KNF
Al Bratkovich–KNF
Steve Johnson–KNF
Lou Kuennen–KNF
Tom Ring–DNRC
Steve Dougherty—ERO Resources, Inc.
Richard Trenholme–IMS, Inc.

Wildlife

Al Bratkovich–KNF
Bruce Haflich–KNF
Pete Strazdas–DSL
Scott McCollough–DNRC
Pete Davis–Environmental Sciences and Engineering, Inc.

Soils

Lou Kuennen–KNF
Pat Plantenberg–DSL
Tom Ring–DNRC
Richard Trenholme–IMS Inc.

Vegetation

Lou Kuennen–KNF
Ted Andersen–KNF
Pat Plantenberg–DSL
Scott McCollough–DNRC
Tom Colbert–IMS Inc.

Visual

Jon Jeresek–KNF
Nancy Johnson–DNRC
Jim Pitts–IMS Consultant

Recreation

Charlie Howard–KNF
Jon Jeresek–KNF
Richard Trenholme–IMS Inc.
Mike Stanwood–IMS Inc.

Transportation

Paul Stantus–KNF
Leonard Slosky–Slosky & Company, Inc.

Land Use

Paul Leimbach–KNF
Mark Kelley–DNRC
Richard Trenholme–IMS Inc.

Socioeconomics

Ron Erickson–KNF
Sandi Olsen–DSL
Art Compton–DNRC
Dan Dodds–DNRC
Mike Stanwood–IMS Inc.

Cultural Resources

Becky Timmons–KNF
Kevin Hart–DNRC
Mark White—KNF, Archaeologist
Marilyn Martorano–Foothills Engineering, Inc.

Sound

Jon Jeresek–KNF
Mark Kelley–DNRC
Howard MacGregor–Engineering Dynamics, Inc.

Comment Analysis

Erma Kaeding–KNF

QUALIFICATIONS OF EIS PREPARERS

Ann Acheson
B.S. Wildlife Biology, Colorado State University
M.S., Earth Resources, Colorado State University

Joe Agapito
A.C.S.M., Mining Engineering, Camborne School of Mines
M.S. Mining Engineering, University of Missouri
Ph.D. Rock Mechanics/Mining Engineering, Colorado School of Mines

Ted Andersen
B.S., Forest Management-Recreation, University of Montana

Al Bratkovich
B.S., Forest and Wildlife Science, Pennsylvania State University

Bill Bluck
B.S. Metallurgical Engineering, University of Utah

Tom Colbert
B.S., Agronomy, Colorado State University
M.Ag., Soils, Texas A&M University

Art Compton
B.S., Engineering Management, U.S. Air Force Academy
M.S., Rural, Town, and Regional Planning, University of Montana

Pete Davis
B.S., Biological Sciences, Michigan Technological University
M.S., Biological Sciences, Michigan Technological University
Ph.D., Wildlife, University of Wyoming

Dan Dodds
B.S., Economics, Southern Illinois University
Ph.D., Agricultural Economics, University of Wisconsin

Pat Driscoll
B.S., Environmental Engineering, Montana College of Mineral Science and Technology

Kevin Hart
B.S., Political Science, Montana State University
M.S., Public Administration, Montana State University

Abe Horpestad
B.S., Botany, Montana State University
M.S., Botany, Montana State University
Ph.D., Botany/Limnology, Montana State University

Charlie Howard
B.S., Forestry and Wildlife, Virginia Polytech Institute

Jon Jeresek
B.S., Social Science and Education, Winona State University
B.S., Forest Resource Conservation, University of Minnesota
M.S., Forest Pathology, University of Minnesota

Nancy Johnson
B.S., Education, University of Nebraska
M.S., Education, University of Nebraska
M.L.A., University of Illinois

Steve Johnson
B.S., Biological Sciences, Colorado State University
M.S., Earth Resources, Colorado State University

Mark Kelley
B.S., Wildland Recreation Management, University of Idaho
M.S., Resource Conservation, University of Montana

Lou Kuennen
B.S., Forestry, University of Idaho
M.S., Forestry, University of Idaho

Nick La Fronz
B.S., Civil Engineering, Arizona State University
M.S.E, Civil Engineering, Arizona State University

Paul Leimbach
B.S., Forestry, University of California

Howard MacGregor
B.S., Aeronautical Engineering, Wayne State University
M.S., Electrical Engineering, University of Denver

Mike Marcus
B.S., Fisheries Biology, Michigan State University
M.S., Limnology, Michigan State University
Ph.D., Zoology/Aquatic Ecology, University of Wyoming

Marilyn Martorano
B.A., Anthropology/Botany, Adams State College
M.A., Anthropology, Colorado State University

Jim Mavis
B.S., Chemistry, San Diego State University

Sandi Olsen
B.A, Biology, Mount Holyoke College

Craig Pagel
B.S., Engineering, University of Idaho

Darcy Pederson
B.S., Physical Education, University of Idaho
B.S. Forest Resource Management, University of Idaho

Doug Perkinson
B.S., Fish and Wildlife Conservation and Management, University of Wyoming

Jim Pitts
B.A., Landscape Architecture, Louisiana State University

Pat Plantenberg
B.S., Agricultural Science, Montana State University
M.S., Range Science/Reclamation, Montana State University

Warner Reeser
B.A., Mathematics, The Colorado College
M.S., Atmospheric Science, Colorado State University
Ph.D., Earth Resources, Colorado State University

Tom Ring
B.S., Fish and Wildlife Management, Montana State University
B.S., Earth Science, Montana State University

Ron Russell
B.S. Forestry, University of Illinois
M.S., Forest Hydrology, University of Illinois

Leonard Slosky
B.A., Environmental Technology Assessment, University of Colorado

Paul Stantus
B.S., Civil Engineering, GonzagaUniversity

Mike Stanwood
B.A., Psychology and Pre-Med, University of Colorado
M.S., Mineral Economics, Colorado School of Mines

Alicia Stickney
B.A., English, Bryn Mawr College
M.S., Geology, University of Montana

Landy Stinnett
B.S., Geological Engineering, South Dakota School of Mines
M.S., Geological Engineering, South Dakota School of Mines
M.S., Mining Engineering, University of Minnesota

Pete Strazdas
B.S., History, Montana State University
M.S., Range Management, Montana State University

Robert Thompson
B.A., Geology, University of Montana

Becky Timmons
B.A., Anthropology, Wichita State University
M.A., Anthropology, University of Montana

Richard Trenholme
B.S., Agronomy, Texas A&M University

Jerry Zimpfer
B.A., Geology, State University of New York
M.S., Earth Resources, Colorado State University
Ph.D., Earth Resources, Colorado State University

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9

GLOSSARY

Adit. A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and unwatered.

Alluvial. Pertaining to material or processes associated with transportation or deposition by running water.

Alluvium. Soil and rock that is deposited by flowing water.

Ambient. Surrounding, existing.

Anticline. A unit of folded strata that is convex upward. In a single anticline beds forming the opposing limbs of the fold dip away from its axial plane.

Bear Management Unit (BMU). A geographic subdivision of Grizzly Bear habitat, which approximates the home range size of a reproductive Grizzly Bear (about 100 square miles in the Cabinet-Yaak ecosystem).

Best Management Practices. Practices determined by the State of Montana to be the most effective and practicable means of preventing or reducing the amount of water pollution generated by non point sources, to meet water quality goals.

Big Game. Those species of large mammals normally managed as a sport hunting resource.

Biological Assessment. An evaluation conducted on Federal projects requiring an environmental impact statement, in accordance with the endangered species act. The purpose of the assessment is to determine whether the proposed action is likely to affect an endangered, threatened, or proposed species.

Borrow Materials. Soil or rock dug from one location to provide fill at another location.

Breached. Said of a folded structure of layered rock which has been eroded to expose at the earth surface the layers that would have otherwise been hidden from view.

Colluvium. Fragments of rock carried and deposited by gravity.

Contact Metamorphism. The process by which rocks surrounding an igneous intrusion are changed in appearance and composition by the heat, pressure and chemicals emanating from that intrusion.

Cuttbow. A common name for a hybrid fish that is a mix of cutthroat and rainbow (or redband) trout. Typically this fish is a mix of native and non-native trout that results from historic fish stocking practices, and sometimes due to habitat degradation.

Drill Seeding. A mechanical method for planting seed in soil.

Endangered Species. Any plant or animal species which is in danger of extinction throughout all or a significant portion of its range. (Endangered Species Act of 1973).

Experimental Redband Population. A group of redband trout (a rainbow native to northwest Montana) that has been partially hybridized with another species. Because the degree of hybridization in this population is low, it is protected by the Forest Service and State sensitive species program and is scheduled for mitigation to conserve the native species.

Floodplain. The lowland and relatively flat areas adjoining inland and coastal waters. A 100-year floodplain is that area subject to a one percent or greater chance of flooding in any given year.

Flotation. A mineral recovery process where individual mineral grains are selectively "floated" and skimmed off the top of an agitated water/chemical bath.

Forage. Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forb. Any herbaceous plant other than a grass, especially one growing in a field or meadow.

Freeboard. The distance from surface of a pond to top of a dam.

Glaciofluvial Deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice.

Glaciolacustrine Deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice.

Hydraulic Conductivity. A measure of the ease with which water moves through soil or rock; permeability.

Hydroseeding. Distributing seed in a spray of water. Mulch and fertilizer may be added to the spray.

Igneous. Describes rocks which have formed from the molten state.

Indicator Species. Species of fish, wildlife, or plants which reflect ecological changes caused by land management activities.

Intrude. To forcefully invade and displace pre-existing rocks. Molten rock can inject itself into surrounding rocks due to high temperatures and pressures.

Joint. Fracture in rock, generally more or less vertical or transverse.

Lacustrine. Lake bed sediments.

Liquefaction. When an earthquake occurs, energy released by rupturing in the earth's crust causes cyclic waves to travel through the rock and soil mass. Saturated soils can then experience enough pressure between the individual grains that the soil loses its cohesion (shear strength) and behaves as a liquid.

Macroinvertebrate. Animals without backbones that are visible without a microscope; insects.

Macronutrient. Elements necessary in large amounts for plant growth.

Make-up Water. Water needed to supplement for water removed by the milling process.

Management Area. Geographic areas, not necessarily contiguous, which have common management direction, consistent with the Forest Plan allocations.

Maximum Credible Earthquake. The largest rationally conceivable earthquake that could occur in a particular area.

Metapopulation. A very large group of fish composed of several distinct sub-populations living in somewhat different environmental conditions. Due to habitat conditions and the behavior of these fish, the various sub-populations are genetically identical due to inter-breeding.

Mitigation. Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

Old Growth Habitat. Old growth is a distinct successional stage in the development of a timber stand that has special significance for wildlife, generally characterized by: (1) large diameter trees (often exceeding 20 inches dbh) with a relatively dense, often multilayer canopy. (2) the presence of large, standing dead or dying trees. (3) down, dead trees, (4) stand decadence associated with the presence of various fungi and heart-rots, (5) an average age often in excess of 200 years, and (6) a basal area ranging from 150 to 400 square feet per acre.

Peak Flow. The greatest flow attained during the melting of the winter snowpack.

Phreatic Surface. The boundary between water saturated and unsaturated soil zone.

Piezometer. A well, generally of small diameter, that is used to measure the elevation of the water table.

Pluton. A body of igneous rock which has intruded beneath the earth's surface. Erosion may later expose these rocks.

Portal. Surface entrance to a mine, particularly to a tunnel or adit.

Potentiometric Surface. The surface or level to which water will rise in a well. The water table is a particular potentiometric surface for an unconfined aquifer.

Probable Maximum Precipitation. The greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a certain time of the year.

Scoping. The procedures by which the agencies determine the extent of analysis necessary for a proposed action, i.e., the range of actions, alternatives, and impacts to be addressed, identification of significant issues related to a proposed action, and establishing the depth of environmental analysis, data, and task assignments needed.

Seepage Collection System. The system of drains, ponds, and pumps to collect and return tailings dam embankment seepage.

Seismic. Of, or produced by, earthquakes.

Sensitive Species. Those species identified by the Regional Forester for which population viability is a concern as evidenced by significant current or predicted downward trends in (a) population numbers or density, or (b) habitat capability that would reduce a species' existing distribution.

Significant. As used in NEPA, requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

Starter Dam. Earthen dams built of borrow material to initiate construction of the tailings impoundment.

Stratabound. A mineral deposit confined to a single layer, bed or stratum.

Stratigraphy. The arrangement of layered rocks, such as in their chronological order, sequence or geographic position.

Subside. Sink to the bottom; settle. (Subsidence).

Syncline. A unit of folded strata that is concave upward. In a simple syncline, beds forming the opposing limbs of the fold dip toward its axial plane.

Tackifier. An agent that binds seed, fertilizer, and mulch to a site, often used when seeding slopes.

Threatened Species. Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Toe Dam. A small dam located at the base of a larger embankment; usually to collect seepage or runoff.

Total Suspended Solids. Undissolved particles suspended in liquid.

Visual Absorption Capability. The capacity for a landscape to accommodate visual change.

Visual Quality Objective. A classification of six goals or "objectives" for management of the visual resource by the USFS.

ABBREVIATIONS AND ACRONYMS

ARM	Administrative Rules of Montana
BHES	Board of Health and Environmental Sciences
BNRC	Board of Natural Resources and Conservation
BMP	Best Management Practices
BMU	Bear Management Unit
BNRC	Board of Natural Resources and Conservation
BPA	Bonneville Power Administration
CFS	Cubic Feet Per Second
CYE	Cabinet-Yaak Ecosystem
DEIS	Draft Environmental Impact Statement
DHES	Department of Health and Environmental Sciences
DNRC	Department of Natural Resources and Conservation
DSL	Department of State Lands
EPA	Environmental Protection Agency
FWS	Fish and Wildlife Service
KNF	Kootenai National Forest
MCA	Montana Code Annotated
MDFWP	Montana Department of Fish, Wildlife and Parks
MEPA	Montana Environmental Policy Act
MFSA	Major Facility Siting Act
MMBF	Million Board Feet
MNHP	Montana Natural Heritage Program
NEPA	National Environmental Policy Act
ROD	Record of Decision
SHPO	State Historic Preservation Officer
T&E	Threatened and Endangered Species
USFWS	USDI-Fish and Wildlife Service
VAC	Visual Absorption Capability
VQO	Visual Quality Objective
WQB	Water Quality Bureau

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APPENDIX A—REVEGETATION MIXTURES AND RECLAMATION SCHEDULE

Table A-1. Revegetation mixture one.

Species		Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq. ft.
Grasses			
Thickspike wheatgrass	*Agropyron trachycaulum*	2.0	7
Redtop	*Agrostis alba*	0.1	11
Meadow foxtail	*Alopecurus pratensis*	0.75	10
Tufted hairgrass	*Deschampsia cespitosa*	0.25	14
Canada wildryez	*Elymus canadensis*	4.0	10
Tall fescue	*Festuca arundinacea*	2.0	10
Common timothy	*Phleum pratense*[2]	0.25	7
Big bluegrass	*Poa ampla*[3]	0.5	10
Forbs[4]			
Virginia strawberry	*Fragaria virginiana*	1-2	10-20
White clover	*Trifolium repens*		
Beargrass	*Xerophyllum tenax*		
Total		10.85 - 11.85	89-99
Shrubs[5]		Planting Rate (Stems/acre)	
Rocky Mountain maple	*Acer glabrum*		
Sitka alder	*Alnus sinuata*		
Western serviceberry	*Amelanchier alnifolia*		
Red-osier dogwood	*Cornus stolonifera*		
Rusty menziesia	*Menziesia ferruginea*		
Swamp gooseberry	*Ribes lacustre*		
Scouler willow	*Salix scouleriana*		
Sitka mountain ash	*Sorbus sitchensis*		
Total		200	
Trees			
Subalpine fir	*Abies lasiocarpa*	85	
Lodgepole pine	*Pinuis contorta*	85	
Engelmann spruce	*Picea engelmannii*	85	
Douglas-fir	*Pseudotsuga menziesii*	180	
Total		435	

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-55.

[1]Rates given are for drill seeding; rates will be doubled for broadcast seeding.
[2]If commercially available, *Phleum alpinum* will be substituted.
[3]If commercialy available, *Poa alpinum* will be substituted.
[4]Seeding rate given is for a combination of any or all species listed.
[5]Planting rate for shrubs is for a combination of any or all species listed based on site conditions such as aspect, moisture, temperature, etc.

Table A-2. Revegetation mixture two.

Species		Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq. ft.
Grasses			
Streambank wheatgrass	*Agropyron riparium*	3.0	11
Thickspike wheatgrass	*Agropyron trachycaulum*	2.0	7
Redtop	*Agrostis alba*	0.1	11
Mountain brome	*Bromus marginatus*	5.0	10
Orchardgrass	*Dactylis glomerata*	0.5	8
Canada wildrye	*Elymus canadensis*	4.0	10
Sheep fescue	*Festuca ovina*	0.5	8
Common timothy	*Phleum pratense*	0.25	7
Canada bluegrass	*Poa compressa*	0.10	6
Forbs[2]			
Common yarrow	*Achillea millefolium*	1-2	10-20
Pearly everlasting	*Anaphalis margaritacea*		
Fireweed	*Epilobium angustifolium*		
Northern sweetvetch	*Hedysarum boreale*		
Silky lupine	*Lupinus sericeus*		
White clover	*Trifolium repens*		
Total		16.45 - 17.45	88-98
Shrubs[3]		Planting Rate(Stems/acre)	
Barberry	*Berberis repens*		
Snowbrush ceanothus	*Ceanothus velutinus*[4]		
Red raspberry	*Rubus idaeus*		
Scouler willow	*Salix scouleriana*		
White spirea	*Spirea betulifolia*		
Common snowberry	*Symphoricarpos albus*		
Baldhip rose	*Rosa gymnocarpa*		
Huckleberry	*Vaccinium globulare*		
Total		200	
Trees			
Western larch	*Larix occidentalis*	85	
Western white pine	*Pinus monticola*	85	
Lodgepole pine	*Pinus contorta*	85	
Douglas-fir	*Pseudotsuga menziesii*	180	
Total		435	

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-55.

[1]Rates given are for drill seeding; rates will be doubled for broadcast seeding.
[2]Seeding rate given is for a combination of any or all species listed.
[3]Planting rate for shrubs is for a combination of any or all species listed based on site conditions such as aspect, moisture, temperature, etc.
[4]*C. sangineus* may be substituted for *C. velutinus* to assess differences in species performance and wildlife use.

Table A-3. Montanore Project reclamation schedule.

Disturbance	Time in years since first year of production: Interim reclamation	Construction period	Operational period	Post-Operational period
Tailings facility				
Impoundment surface	1-16			17-18
Main embankment	1-16			17-18
Toe Dike	-1-14		15-16	
North saddle dam	10-11			17-18
South saddle dam				17-18
Diversion dam		-2		
Diversion channel		-1		
Seepage dam	-1			18+
Seepage pond	-1			18+
Seepage ditches	-1			18+
Borrow area	-1			
Roads (access, haul)	-1			17-18
Soil stockpiles/sites	-2-16			17-18
Water control structures	-1			17-18
Pump station	-1			17-18
Plant site				
Cut/fill slopes		-1		
Patio				17-18
Temporary access road	-1		1	
Soil stockpiles/sites	-1			17-18
Water control structures	-1			17-18
Portals				17-18
Portal patio	-1			17-18
Libby Creek adit area				
Portal				17-18
Patio				17-18
Waste rock dump			-1	
Percolation pond				17-18
Soil stockpile/site	-2			17-18
Water control structures	-2			17-18
Transportation corridors				
Bear Creek access road		-2		
Tailings/plant site corridor	-1			17-18
Powerline corridors	-2			17-18

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-92.

APPENDIX B—MONITORING

THE agencies have developed various environmental monitoring programs which would be implemented as part of Alternatives 2 and 3. The programs would begin in the first quarter of construction of the mill and tailings impoundment and be maintained during the life of the project. Noranda's interim monitoring, described in Chapter 2, would be continued up to the time of implementing the operational monitoring plan. The goals of these monitoring programs are to (1) quantify any measurable environmental impacts accompanying construction, operation, and reclamation of the Montanore Project; (2) evaluate the accuracy of projected impacts; and (3) determine whether alterations of project operations or additional mitigative actions are required to correct any unanticipated impacts encountered or to prevent future violations of regulatory requirements. The remaining sections of this appendix describe these programs and their specific monitoring objectives.

MONITORING DATA REVIEW AND PROGRAM MODIFICATION

Professional review of the monitoring data would be required as the best currently available approach to assess the possible presence of short- or long-term impacts resulting from the Montanore Project. Hydrologists or other appropriate professionals from the KNF, the DHES, and the DSL would review the hydrology monitoring data. Aquatic and fisheries biologists or other appropriate professionals from the KNF, the DHES, Montana Department of Fish, Wildlife and Parks would review collected aquatic data. Air monitoring data would be reviewed by the DHES and the USFS. Noranda would prepare quarterly and annual reports for all monitoring studies. The following discussion applies to the hydrology monitoring. Other studies would have similar reporting requirements.

Noranda would prepare a report briefly summarizing hydrologic information, sample analysis and quality assurance/quality control procedures following each sampling interval. An annual report would

summarize data over the year. All monitoring data would be submitted to the agencies in an electronic form suitable to the agencies. The annual report would include data tabulations, maps, cross sections and diagrams needed to describe hydrological conditions. Raw lab reports and field and lab quality control results also would be reported. In the annual report, Noranda would present a detailed evaluation of the data. Data would be analyzed using routine statistical analysis, such as an analysis of variance, to determine if differences exist for conditions such as—

- between sampling stations;
- between an upstream reference station and the corresponding downstream station;
- between sampling time (monthly, growing season/non-growing season);
- between stream flow at time of sampling (for example, low flow during the fall compared to low flow during the winter); or
- between sampling years.

Data would be reviewed by the DHES, the DSL and the KNF. A conceptual monitoring data review plan is shown in Figure B-1. Specific actions by the agencies would depend on the actual monitoring data results. Data would be submitted to the reviewing agencies by Noranda within a reasonable time (5-7 weeks) after each sampling trip, as discussed in a later section of this plan. If a representative of any of these reviewing agencies or Noranda determines that there is a need for a formal review meeting involving the three groups, such a meeting would be arranged within two weeks of Noranda's submitting the monitoring report to the agencies. The formal review meeting would involve representatives from the reviewing agencies and Noranda, and would be open to interested observers. The formal review would include evaluating probable natural, historical, or mine-related causes for any changes observed, and determining the potential seriousness and implications of any detected change. The agencies' internal or formal review could result in various outcomes, as determined by the agencies—

- Determine that no change in the monitoring programs or mine operation plans is needed;
- Recommend modifications to the monitoring programs;
- Recommend that new treatment or mitigation measures be implemented as part of the mine operation plan; or
- Upon finding that activities associated with the Montanore Project have resulted in or will result in the pollution of surface or ground waters, require Noranda to implement necessary measures to ensure compliance with applicable laws and regulations (Montana Water Quality Act and Administrative Rules of Montana).

Recommendations from the review would be implemented through administrative processes of the Forest Service and the State of Montana.

Agency Roles and Responsibilities

The agencies would maintain active jurisdiction for overseeing and regulating operations at the Montanore Project, under purview of approvals and permits issued to Noranda by the agencies. A significant part of agency involvement would be to oversee monitoring and related independent QA/QC activities. As appropriate, agencies would accompany Noranda personnel in the field during sampling episodes both to observe sampling activities and collect sample splits for analysis. Noranda and agency generated data would be reviewed and evaluated, with agencies making determinations with respect to performance standard compliance by Noranda. Noranda would be responsible for the cost of the monitoring programs. The agencies would be responsible for funding any additional compliance monitoring.

Environmental monitoring would document compliance of operations at the Montanore Project with various performance standards dictated by regulatory requirements or by specific permit conditions or when interpretation of monitoring results indicate standards will not be achieved. Whenever

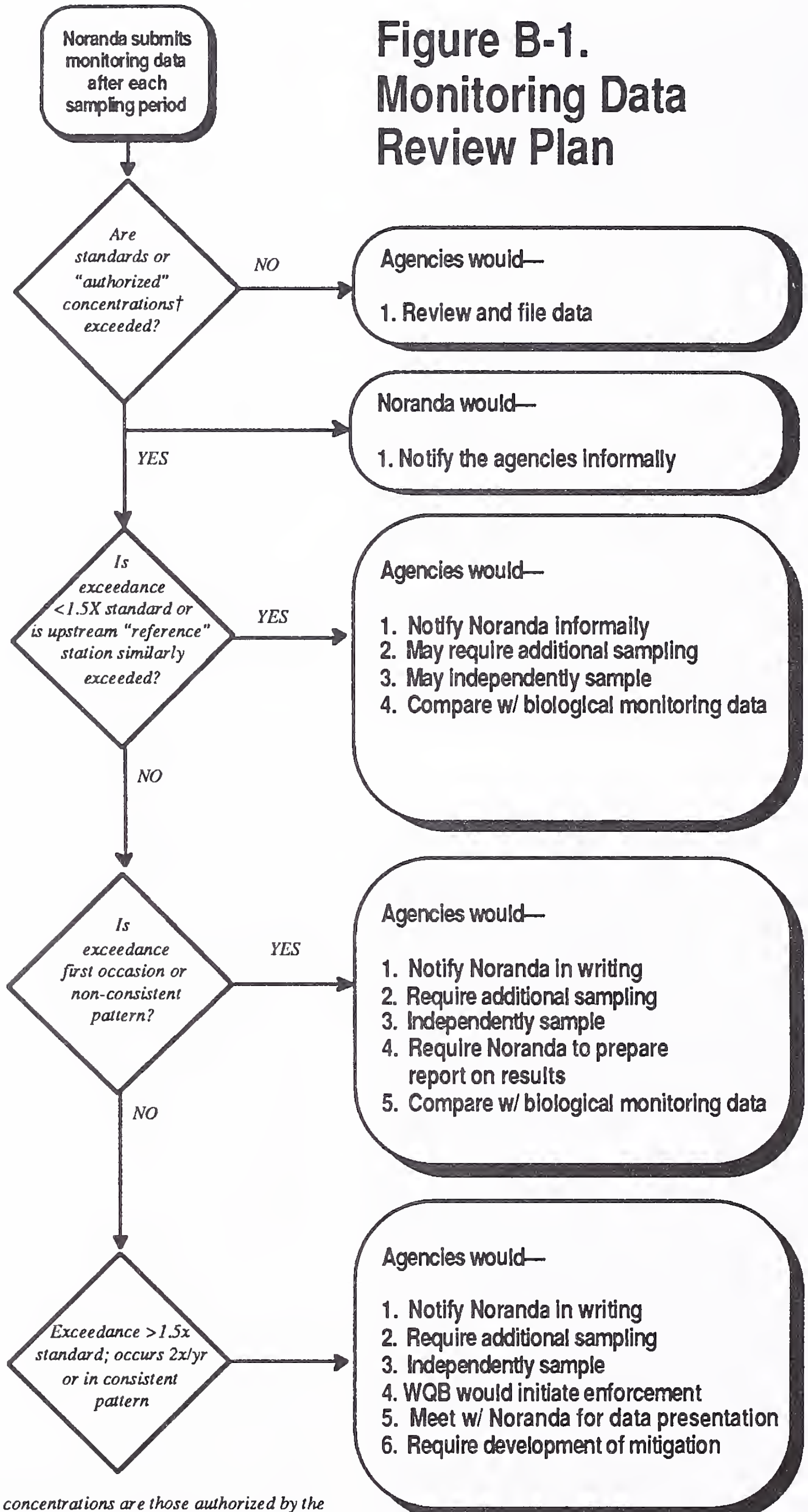

Figure B-1. Monitoring Data Review Plan

†Authorized concentrations are those authorized by the Board of Health and Environmental Sciences following consideration of Noranda's petition to change the quality of ambient waters.

performance standards—such as surface or ground water quality standards—have not been achieved, it would be incumbent upon Noranda to respond with appropriate corrective actions. In certain instances, corrective actions would be proposed by Noranda. In other cases, corrective actions may be dictated by a regulatory agency in a notice of violation or other regulatory action.

Quality Assurance/Quality Control

Ongoing environmental monitoring would be conducted for air and water quality, aquatic biology, and tailings dam stability. As part of each protocol for environmental monitoring, Noranda would develop quality assurance/quality control (QA/QC) procedures for each of these areas. These procedures would collectively comprise a QA/QC plan, the overall goal of which would be to ensure the reliability and accuracy of monitoring information as it is acquired. QA/QC procedures would include both internal and external elements. Internal elements may include procedures for redundant sampling such as random blind splits or other replication schemes, chain of custody documentation, data logging, and error checking. External procedures may include audits and data analyses by outside specialists, and oversight monitoring and data checking conducted by various regulatory agencies.

Written reports to document the implementation of the QA/QC plan would be an integral part of monitoring reports. If variances or exceptions to established sampling or data acquisition methods are detected during monitoring, they would be appropriately documented. These would include a discussion of the significance of data omissions or errors, and measures taken to prevent any reoccurrences. Required reports would be submitted to the appropriate agencies.

Summary of Monitoring Plans

Table B-1 summarizes the proposed monitoring plans and the frequency proposed for each plan. As discussed in the *Hydrology* section, Alternative 3C would require additional monitoring as shown in Table B-1.

HYDROLOGY

The following discussion of surface and ground water monitoring provides the proposed monitoring which would be implemented under Alternatives 2, 3A, or 3B. Under Alternative 3C, Noranda would implement a more detailed water quality monitoring program (beyond that discussed in this section). Additional monitoring wells would be installed in and around the Little Cherry Creek LAD area. Prior to discharge in the Little Cherry Creek LAD area, adequate baseline water quality information would be collected from the wells.

Excess adit and mine waters would be sampled with sufficient frequency to determine actual average concentrations and loads of nitrates and ammonia discharged. For example, the temporary water storage pond would be sampled once-a-month when it is in use. The pond would mix the fluctuating nitrate and ammonia concentrations and provide information of what an "average" concentration would be. Adit and mine water also would be sampled directly. For example, samples of adit and mine water would be "composited" on an hourly basis over a 24-hour period. During the first six months, composite samples would be collected and analyzed for nitrates and ammonia twice a month. During the next six months, sampling and analysis frequency would alternate between every-other day in one month and twice-a-month in the next month. For example, if the second six month period began in July, samples would be collected every-other day in July and twice-a-month in August. Noranda would provide the agencies with information concerning its blasting cycle to ensure the adit and mine water samples are representative. Sampling frequency in subsequent years would be decided at the annual meeting (discussed in the following section).

Table B-1. Proposed monitoring plans, locations and frequencies.

Monitoring plan	Location	Parameters	Sampling frequency
Surface and ground water hydrology			
Alternatives 2, 3A, and 3B	Around project facilities (see Figure B-2)	Major cations and anions; nutrients and metals (see Table B-3)	Five times per year
Alternative 3C (Ground water)	Around project facilities (see Figure B-2); additional wells installed in Little Cherry Creek LAD area	Major cations and anions; nutrients and metals (see Table B-3)	Monthly
Alternative 3C (Surface and ground water)	LAD areas (see Figure B-2); additional wells installed in Little Cherry Creek LAD area	Major cations and anions; nutrients and metals (see Table B-3)	Twice-a-month following increase in nitrates or ammonia in ground water; monitoring frequency in subsequent years based on first year's results.
Alternative 3C (Surface and ground water)	Excess adit or mine water	Major cations and anions; nutrients and metals (see Table B-3)	Monthly
Alternative 3C (Surface and ground water)	Excess adit or mine water	Nitrate, nitrites and ammonia	Sufficient frequency to determine average concentration of discharged waters (see text)
All alternatives	Water balance	Inflows and outflows to project facilities	Daily with monthly averages
All alternatives	Rock Lake and Saint Paul Lake	Water levels	Twice-a-year
Fish and other aquatic life			
	Around project facilities (see Figure B-2)	Routine physical and chemical parameters; fine sediments; aquatic insects; algae and other micro-organisms	Three times per year
	Downstream of project facilities (Station L1, see Figure B-2)	Fish population	Once every three years
	Downstream of project facilities (between stations L1 and L3, see Figure B-2)	Cadmium, lead, and mercury concentrations in fish tissue	Every other year
	Excess adit and mine water; tailings water	Toxicity testing (see text)	Annually
Tailings impoundment dam stability			
	Downstream slope and toe of the tailings impoundment dams	Seepage	Daily visual inspection
	Pressure relief well system	Water levels	Monthly during first 5 years
Air quality			
	Plant area/tailings impoundment	Particulates	Every third day
	Tailings impoundment	Wind speed and direction	Continuous

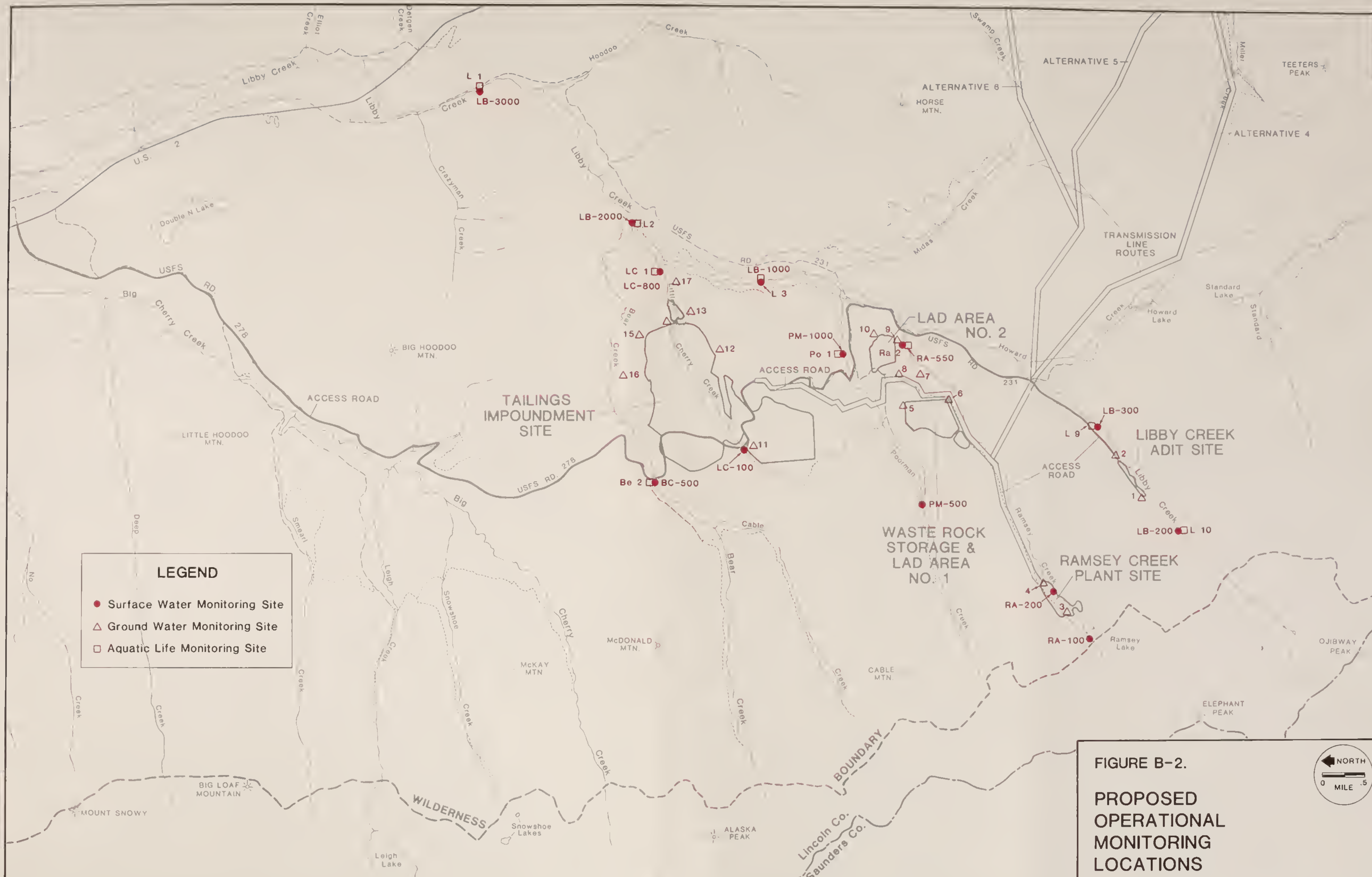

FIGURE B-2.

PROPOSED OPERATIONAL MONITORING LOCATIONS

Ground water monitoring locations would be sampled monthly whenever excess water is discharged (anticipated during the construction phase and beginning in Year 10 of operations). If nitrate or ammonia concentrations increase in ground water, twice-a-month monitoring of all surface and ground water stations potentially affected by discharges would begin. Monthly monitoring of ground water would continue for at least a year following cessation of discharges. At the end of the first monitoring year and following submittal of the annual report, Noranda would meet with the agencies to discuss the monitoring results and evaluate the effectiveness of the land application treatment system. Following the annual review, the agencies would decide whether a change in monitoring or operations would be required (see the previous *Monitoring Data Review and Program Modification* section). When twice-a-month monitoring is not required, monitoring would occur five times per year. Noranda would present the details of the additional monitoring in the final water management/treatment plan to be submitted to the agencies for review and approval.

Surface Water

Area streams. Surface water would be monitored for quality and flow in Ramsey, Poorman, Little Cherry, Bear and Libby creeks. During the baseline study, surface water monitoring stations were established in these drainages to determine baseline conditions and seasonal fluctuations in flow and quality. Proposed monitoring stations are presented in Table B-2 and shown on Figure B-2. Sampling periods would include March (early spring low flow), June (spring high flow), September (late summer low flow), November (fall low flow), and January or February (winter low flow). These months are based on the continuous flows measured at Granite Creek. A year-round flow station would be installed at LB 2000 to monitor flow and suspended sediments continuously. The months of measurement may be changed depending on the results of the continuous flow measurements at LB 2000. The proposed analytical protocol is shown in Table B-3.

Lake levels. Lake levels in Rock Lake and Saint Paul Lake would be monitored. The proposed monitoring program would focus on identifying lake water levels during high and low water level periods. Water levels would be measured twice each year, once after snow melt and ice break up in June or early July and once during late summer low-water in late August or September. A datum would be established at each lake by marking a point on a large rock or cliff adjacent to the lake shore. A description and photograph of the datum would be maintained in the monitoring file to allow easy identification and location of the monitoring point. Water levels would be measured relative to the datum with a tape measure, hand level and rod or a fixed staff gage depending on the characteristics of each site.

Ground Water

Ground water would be monitored downstream of all project facilities. Ground water monitoring locations are shown in Table B-4 and on Figure B-2. Ground water sampling would be conducted at the same time as the surface water sampling. Noranda and the agencies would use standard ground water modelling techniques and "tracer compounds" such as nitrate, total dissolved solids and potassium to evaluate the effects of Noranda's discharges and to predict impacts to surface water. Ground water monitoring would provide information on changes in water quality prior to changes occurring in surface water. Seventeen interim monitoring wells and additional monitoring wells planned for the Montanore Project include the following—

- Up-gradient and down-gradient of the plant site, and down-gradient of the Ramsey Creek land application disposal area;
- A series of monitoring wells associated with the tailings pond pressure relief system and down-gradient of the seepage collection pond; and
- Down-gradient of the Libby adit portal and water disposal area.

Table B-2. Proposed surface water monitoring stations.

Station	Location	Purpose
Libby Creek		
LB 200	Above Libby Creek adit	Provide reference station on upper Libby Creek
LB 300	Upstream of the Howard Creek confluence	Assess potential impacts from the Libby Creek land application disposal area
LB 1000	Downstream of Poorman Creek and Midas Creek confluences	Assess potential cumulative impacts from Ramsey Creek and Libby Creek land application disposal area and plant site
LB 2000	Downstream of Little Cherry Creek confluence	Assess potential impacts from tailings impoundment
LB 3000	Upstream of the Crazyman Creek confluence	Assess potential cumulative impacts from upstream sources
Ramsey Creek		
RA 100	Above Ramsey Creek plant site	Provide reference station on upper Ramsey Creek
RA 200	Below Ramsey Creek plant site	Assess potential impacts from the plant site
RA 550	Above Libby Creek	Assess potential impacts from the plant site and Ramsey Creek land application disposal area
Little Cherry Creek		
LC 100	Above tailings impoundment	Provide reference station on upper Little Cherry Creek
LC 800	Above Libby Creek	Assess potential impacts from tailings impoundment
Poorman Creek		
PM 500	Upstream on Poorman Creek	Provide reference station on upper Poorman Creek
PM 1000	Upstream from the Libby Creek confluence	Assess potential impacts from Ramsey Creek land application disposal area
Bear Creek		
BC 500	Upstream from any disturbance and above U.S.F.S. Road #278	Provide reference data from an undisturbed tributary station

Source: Hydrometrics, Inc. 1989.

Table B-3. Proposed analyses for surface and ground water samples.

Specific conductivity (1.0)†	Flow or static water level (wells)
Total suspended solids (1.0)	Aluminum (0.1)
Total dissolved solids (1.0)	Arsenic (0.005)
Sodium (1.0)	Cadmium (0.0001)
Calcium (1.0)	Chromium (0.004)
Magnesium (1.0)	Copper (0.001)
Potassium (1.0)	Iron (0.05)
Carbonate (1.0)	Lead (0.0007)
Bicarbonate (1.0)	Manganese (0.02)
Chloride (1.0)	Mercury (0.0002)
Sulfate (1.0)	Silver (0.0002)
Nitrate as N (1.0)	Zinc (0.02)
Nitrite (1.0)	Field Temperature (°C)
Total Kjeldahl nitrogen as N (0.2)	Total alkalinity (as $CaCO_3$) (1.0)
Total phosphorous as P (0.005)	Total hardness (as $CaCO_3$) (1.0)
Ammonia (0.05)	Turbidity (0.1)
pH	

Source: Chen-Northern, Inc. 1991b; revised by the agencies.
†Proposed analytical detection limits are shown in parentheses in mg/L.

Table B-4. Proposed ground water monitoring sites.

Well no.	Location	Purpose
Libby Creek drainage		
1, 2	Down-gradient of adit facilities	Assess potential impacts from the Libby Creek land application disposal area
Ramsey Creek drainage		
3	Up-gradient of plant site	Provide reference station on upper Ramsey Creek
4	Down-gradient of plant site	Assess potential impacts from the Ramsey Creek plant site
5, 6, and 7	Down-gradient of land application disposal area 1	Assess potential impacts from the Ramsey Creek land application disposal area
8, 9, and 10	Up-gradient of land application disposal area 2	Assess potential impacts from the Ramsey Creek land application disposal area
Little Cherry Creek drainage		
11	Up-gradient of tailings impoundment	Provide reference station on upper Little Cherry Creek
12 through 17	Down-gradient of tailings impoundment	Assess potential impacts from tailings impoundment

Source: Hydrometrics, Inc. 1989.

Water levels relative to the established datum would be recorded in a permanent file and a photograph of the lake shore/datum would be filed with date and location written on the photo. During mine operation, the monitoring frequency would be reevaluated on an annual basis. If substantial inflows to the mine occur in the vicinity of any of the lakes, Noranda would report inflows to the agencies within 48 hours and the need for additional water level monitoring would be evaluated. Lake water level data would be tabulated and included in the annual hydrologic monitoring report prepared by Noranda for the project. If the lake levels are not affected, and Noranda does not encountered increased inflows near the fault, Noranda would mine closer than the proposed avoidance distances (see Chapter 2).

Water Balance

Noranda would maintain a detailed water balance of inflows and outflows to project facilities. The purpose of the balance would be to provide an assessment of the mine and tailings water inflows and outflows. The monitoring information would be used to modify, as necessary, operational water handling and to develop a post-mining water management plan. As part of this monitoring, Noranda would measure—

- daily mine and adit discharges;
- the amount of tailings (coarse and fine) slurried to the impoundment and the percent solids of the slurry;
- the amount and source of fresh makeup water used by the mill;
- the amount of reclaimed tailings water sent to the mill;
- the amount of water from the seepage collection pond pumped back to the impoundment;
- the amount of water collected by the seepage collection/pressure relief wells and pumped back to the impoundment;
- the amount and source of water sent to the dust suppression system; if any
- the amount and source of water sent to the enhanced evaporation sprinkler system; if any
- the amount and source of water discharged to the land application disposal area, if any;
- pan evaporation technique at Little Cherry Creek impoundment site; and
- the amount of precipitation received at Little Cherry Creek impoundment site.

These measurements would be provided as monthly (or more frequently if requested by the agencies) and annual averages and totals in an quarterly hydrology report. If mine and adit inflows greater than 1,200 gpm occur over a two-month period or if excessive tailings water occurs or is anticipated, Noranda would notify the agencies within two weeks. Noranda's excess water contingency plans, described in Chapter 2, would then be implemented. If excess inflows occur near the Rock Lake Fault, Noranda would evaluate the possible connection to surface water bodies and provide an evaluation report to the agencies.

In conjunction with monitoring of mine and adit flows, Noranda would collect water samples of inflows seasonally. Water collected by the pressure relief/seepage interception system would be sampled seasonally in conjunction with the surface water sampling. Samples would be analyzed for the parameters shown in Table B-3.

Best Management Practices Implementation and Effectiveness

Noranda would implement the Best Management Practices (BMP) listed in Appendix G for all surface disturbing activities. A KNF representative would document the actual implementation of all BMPs, using an established KNF Implementation Documentation Form. Such documentation would ensure that the BMPs were installed satisfactorily. Additional documentation by a KNF Representative also would be completed in late fall of each year when a BMP

may still be needed to control erosion and protect water quality. For example, road maintenance and snow removal BMPs would be monitored for the life of the project, but a BMP implemented to control erosion from the tailings pipeline corridor may not have to be monitored once vegetation is re-established. The KNF would ensure that BMPs would be installed and monitored for all areas where erosion could potentially affect water quality. Documentation of post-implementation monitoring would use a form similar to the KNF BMP Implementation and Effectiveness Evaluation Form. This form would document the effectiveness of individual practices, and also would provide the mechanism for improving BMPs on future projects.

Sample Collection and Data Handling

Collection, storage and preservation of water samples would be in accordance with EPA procedures (EPA-600/4-4-82-029). Grab samples would be collected from streams and ground water samples would be obtained with a bailer or a submersible pump. Samples would be cooled immediately after collection. Metals in water samples would be preserved by adding nitric acid in the field to lower the pH to less than 2.0. Ground water samples for metals analysis would be field filtered through a 0.45 micron filter to allow measurement of dissolved constituents. Chemical analysis of water samples would be by procedures described in 40 CFR 136, EPA-600/4-79-020, or methods shown to be equivalent. All field procedures would be consistent with procedures described in the U.S. Geological Survey's National Handbook of Recommended Methods for Water-Data Acquisition.

A specific quality assurance/quality control (QA/QC) program is proposed by Noranda to guarantee the quality and source of all data collected during the operational monitoring phase of this project. This program includes sample documentation, sample control and data validation and is conformable to the baseline QA/QC program. Specifics of the proposed QA/QC program are presented in Noranda's permit application (Noranda Minerals Corp., 1989a).

The documentation/sample control portion of the QA/QC plan is designed to document and track the samples from the time of collection through reporting of the analytical results. Elements in this portion of the plan include sample identification protocol, the use of standardized field forms to record all field data and activities, and the use of chain-of-custody, sample tracking and analysis request forms. Noranda would develop a master file of all field forms and laboratory correspondence.

The purpose of data validation is to ensure that data collected during the monitoring phase is of known and acceptable quality. Identical sample collection and sample analysis methodologies would assure that data collected during the monitoring program would be comparable to baseline data. Representativeness would be ensured by locating sampling stations in representative areas and through the submittal of quality control samples. Quality control samples would include blind field standards, field cross-contamination blanks and replicate samples. Field cross-contamination blanks would be inserted at a minimum frequency of 1 in 20. Blind field standards and field replicates would be inserted into the sample train at a minimum frequency of 1 in 20. In addition, the use of an EPA-approved laboratory would ensure that laboratory internal QA/QC requirements are met.

AQUATIC LIFE

The agencies have developed a comprehensive aquatic life monitoring program for the Montanore Project. Aquatic biological monitoring—

- provides data to assess the ecological health of these resources;
- integrates effects from all pollutant sources, thereby providing measures of cumulative effects;
- is inexpensive, relative to extensive chemical monitoring;
- directly addresses public concerns; and

- may be the best practical means to assess effects when specific ambient physical or chemical criteria are not available, cannot be defined, or cannot be measured.

Little scientific information exists on aquatic life relationships in habitats with extremely low concentrations of dissolved nutrients and very low productivities, such as occur in the Libby Creek drainage. Consequently, only very limited information exists for projecting potential aquatic effects associated with the Montanore Project, and the accuracy of any such projection can be appropriately questioned. Also, high natural variability associated with the natural environmental extremes in the Libby Creek watershed ultimately limit the predictive value of results from all pre-permit field studies in the Libby Creek watershed or any new laboratory studies using water from this system. Any such studies would almost certainly not reflect the extremes or combinations of natural conditions experienced during the life of the proposed mine. Because of these uncertainties, biological monitoring would be conducted as an operational requirement for the project.

The goals of aquatic biological monitoring would be to 1) evaluate conformance with permit conditions 2) quantify possible effects to aquatic life in the Libby Creek watershed resulting from the Montanore Project and 3) determine whether altered project operation or additional project mitigation may be required in response to suspected effects. Aquatic biological monitoring would be coordinated with the surface water quality monitoring program.

For these studies, effects would be determined by comparing data collected from six downstream monitoring stations to data collected during pre-construction baseline studies from all sampling stations, and to data collected during operation and post-operation reclamation from two reference monitoring stations. The following subsections present the biological monitoring objectives, identify monitoring stations, and describe the environmental parameters to be monitored.

Biological Monitoring Objectives and Review Criteria for Impact

The objectives of this monitoring program are to—

- document seasonal physical and chemical features for each aquatic biological monitoring station;
- document seasonal fluctuations in sediment accumulation at the monitoring stations;
- document the seasonal diversity and relative abundance of macroinvertebrate species present at each monitoring station;
- document the seasonal diversity and abundance of periphyton populations at each monitoring station;
- monitor changes in fish populations through a single downstream reach in Libby Creek;
- identify indicator species, marker species and species of special concern within the project area and document the annual population status of those species;
- document possible changes in cadmium, mercury and lead concentrations in fish downstream of mining activities;
- evaluate the potential toxicity to aquatic organisms of waters contained in the percolation and tailings ponds, and document any such toxic conditions developing downstream of these ponds in Libby Creek;
- assess the environmental condition of streams sampled during the field season and indicate any noticeable perturbations;
- compare each year's monitoring data with other monitoring and baseline data to define the annual dynamics of these stream systems and to identify any possible mine related effects to these systems; and
- recommend future monitoring needs.

Plafkin et al. (1989) suggest that values for biological parameters monitored at a station often remain naturally within 60 to 80 percent of the average values, as defined seasonally by baseline and reference monitoring data. When parameter values deviate more than about 50 percent from their respective average reference values, there is

increasingly likelihood that new factors are affecting the biological community in the system. "New factors" can include those originating in nature or be man-made.

These relationships suggest that a greater than 50 percent deviation from average reference values found during a monitoring program could indicate possible impacts to aquatic life, particularly if it occurs in two successive sampling periods (see Figure B-1). This value, however, has limited use for assessing changes in the Libby Creek system. In Libby Creek, considerable natural variability is associated with seasonal flushing events which frequently displace or destroy many forms of aquatic life. Samples collected shortly after these events often contain few to no fish, aquatic insect, or periphytic algae. With time, periphyton populations begin to rebuild toward previous population densities over several days to a few weeks, and aquatic insect and fish populations reestablish over several weeks to a few months, depending on the season. The rebuilding occurs until the next flushing event, which may occur in a few weeks or in many months. This rebuilding process is relatively slow in the Libby Creek system, however, because of its naturally low nutrient concentrations and productivities. Thus, it is doubtful whether the aquatic community in the Libby Creek watershed ever approaches anything resembling a "stable" community. This makes calculating "average" reference conditions, or any other statistical measure summarizing environmental conditions, a task that has no practical meaning for this system. With data ranges that can include values frequently near or equal to zero as the lower natural values for monitored parameters, it is extremely difficult, using conventional statistical procedures, to produce meaningful judgements of significant differences (i.e., actual adverse impact) about the monitoring data collected.

Monitoring Locations and Times

Eight monitoring locations are proposed (Table B-5 and Figure B-2). A station (L 10) on Libby Creek, upstream of all project activities, would provide reference data. Tributary stations just above the confluences of Libby Creek with Ramsey Creek (Ra 2), Poorman Creek (Po 1), and Little Cherry Creek (LC 1) would monitor potential effects in those drainages. A station on Bear Creek (Be 2) would provide data from a tributary reference station.

Four additional Libby Creek stations (L 1, L 2, L 3, and L 9) would monitor potential effects on aquatic life in Libby Creek. The most downstream station (L 1) is downstream of all project activities; it would provide data on cumulative effects from all activities upstream in the watershed. Station L 2 would provide data on the cumulative effects in conjunction with a continuous surface water flow monitoring station. Collectively, Stations L 10 and Be 2 would be described as the "reference monitoring stations," while Stations L 1, L 3, L 9, Ra 2, Po 1, and LC 1 would be called the "downstream monitoring stations." Monitoring would occur during three periods—in April prior to run-off, in August during late summer flows, and in October prior to ice forming in the streams.

Fine Sediments

An estimation of the seasonal variation of fine sediment loading at each sampling station is important because fine sediments (particles less that 0.25 inch in diameter) can have both detrimental and beneficial effects on aquatic biota. Those effects depend on size and amount of sediment deposited, and time of year and duration of the deposition. Because of extreme annual high flows, streams in the project area naturally contain low amounts of fine sediment. While some sediment introduction may benefit the biota of the Libby Creek drainage, prolonged or extensive heavy sediment loads could adversely affect taxa diversity and density of sediment sensitive species, reducing benthic invertebrate populations necessary as food stocks for fish over the short or long terms. Sediment accumulation can also adversely impact spawning areas for fish.

Routine Physical/Chemical Features

Routine physical and chemical parameters for each monitoring station would be measured at the time of sample collection. They would include air and water temperature, stream width and depths, discharge, pH, total alkalinity, specific conductance, and sulfate. Standard methods would be used.

Fine sediments accumulation at the monitoring stations would be assessed using two methods. First, embeddedness, the degree to which boulders, cobble and gravel are surrounded by fine sediment, would be visually estimated at the time of benthic sampling using an embeddedness rating description (Platts et al., 1983). The qualitative ratings, from 1 to 5, estimate the percentage of larger sized particles covered by fine sediment. The embeddedness rating evaluates the suitability of stream substrate for fish reproduction and supporting benthic invertebrate populations.

Table B-5. Proposed aquatic life monitoring stations.

Station†	Location	Purpose
Libby Creek		
L 10 (LB-200)	Above Libby Creek adit	Provide reference station on upper Libby Creek
L 9 (LB-300)	Upstream of the Howard Creek confluence	Assess potential impacts from the Libby Creek land application disposal area
L 3 (LB-1000)	Downstream of Poorman Creek and Midas Creek confluences	Assess potential cumulative impacts from the Ramsey Creek and Libby Creek land application disposal area, and plant site
L 2 (LB-2000)	Upstream of Bear Creek	Assess potential cumulative impacts from upstream sources in conjunction with continuous surface water flow monitoring
L 1 (LB-3000)	Upstream of the Crazyman Creek confluence	Assess potential cumulative impacts from all upstream sources
Ramsey Creek		
Ra 2 (RA-600A)	Upstream from the Libby Creek confluence	Assess potential impacts from the Ramsey Creek plant site and land application disposal area
Poorman Creek		
Po 1 (PM-1000)	Upstream from the Libby Creek confluence	Assess potential impacts from Ramsey Creek land application disposal area
Little Cherry Creek		
LC 1 (LC-800)	Upstream from the Libby Creek confluence	Assess potential impacts from tailings impoundment
Bear Creek		
Be 2 (BC-500)	Upstream from any disturbance and above U.S.F.S. Road #278	Provide reference data from an undisturbed tributary station

Source: Western Technology and Engineering, Inc. 1991a; revised by the agencies.
†Corresponding hydrology monitoring station numbers are shown in parentheses.

Second, the square grid method would be used to determine quantitatively the percentages of fine sediment in representative pool, riffle, and run habitats at each monitoring station. Briefly, this method consists of throwing a one-foot-square, metal grid into the stream and viewing the grid through a plexiglass viewing box to determine the percentage of grid crossings that lay above fine sediments. This procedure is completed ten times for each habitat type (i.e., pools, riffles, or runs) found at each station (Kramer and Swanson, 1991).

Benthic Macroinvertebrates

Bottom dwelling, or benthic, macroinvertebrates are widely recognized as useful indicators in aquatic monitoring programs (Plafkin et al. 1989). Aquatic monitoring for the Montanore Project would include collecting a variable number of "quantitative" and "qualitative" samples from each station during each sampling visit beginning with construction. The number of samples would be based on the variability of the baseline data. Quantitative benthic samples would be collected using a 500-micrometer mesh Hess net equipped with a Dolphin plankton bucket attached to the end of the net. Samples would be collected from the riffle/run habitats in the stream. Specific sampling locations at each station would be standardized, to the extent possible, for depths between 0.5 and 1.5 feet and flow velocities of less than 1.5 feet per second.

The qualitative sample would be collected with the kick net in habitats not sampled during collection of the quantitative samples. Benthic macroinvertebrates collected with the kicknet would be used to supplement the quantitative list and to determine the relative abundance of the taxa inhabiting aquatic habitats at the sampling station.

Because the numerous interstitial spaces under and around boulders are inaccessible using standard quantitative collecting methods, substrate coarseness in project area streams makes thorough quantitative sampling virtually impossible. Therefore, to obtain a more substantial representation of the benthic community, a qualitative sample would be collected using a 500-micrometer mesh bottom kick net during each biological monitoring visit to each station. A unit-effort (60 seconds) kick net sample would be collected from the various micro-habitats present at each station.

Parameters used to analyze the benthic data would follow those of Plafkin et al. (1989). The parameters would include the total number of individuals collected, taxa richness, EPTC abundance (i.e., total percent relative abundance of mayflies, stoneflies, caddisflies, and true midges), percent relative abundance for each taxa, percentage of indicator and/or marker species, seasonal and site variations, Shannon diversity index, and ratio of functional feeding groups. To summarize these data, four common statistical measures will be used (mean, standard deviation, coefficient of variation, and standard error of the mean), plus other appropriate measures (U.S. EPA, 1990).

To provide quality control and quality assurance for these studies, a permanent taxonomic reference collection would be maintained that contains all benthic species collected from project area streams. Taxa identification in this collection would be documented and confirmed by taxonomic experts selected with concurrence of the agencies. This reference collection would be maintained by Noranda through the period of post-operational monitoring. Following this period, the collection would be transferred to a depository selected by the agencies for permanent scientific reference.

Periphyton

Periphyton is the community of algae and other microorganisms that grow attached to rocks and other solid substrates in streams and lakes. Algae are generally the source of most primary production (photosynthesis) in streams, are one of first groups to colonize an area following disturbance, and include many species that are useful indicators of

water quality conditions. Because of these relationships and because periphyton communities remain at specific locations while integrating changes in water quality, many studies have found that periphyton are particularly useful to monitor and assess environmental effects. Thus, periphyton monitoring can be particularly valuable in the Libby Creek watershed, where frequent high-volume runoff events destroy or flush many fish and invertebrates downstream, temporarily limiting the usefulness of these two taxonomic groups for aquatic biological monitoring.

Periphyton populations would be sampled at the eight monitoring stations concurrent with the proposed benthic insect population sampling episodes in April, August, and October. At each station, scrapings of periphyton would be collected from surfaces of stones and other natural substrates over the range of habitat structures, water depths, and velocities found. The scrapings would be composited and preserved in separate containers for each station. In the laboratory, major periphyton taxa would be identified by genus or species, as much as possible, and counted using standardized methods. For diatoms, permanent slide mounts would be prepared.

Data reports would include lists of the major taxa identified and their relative proportions by numbers or biomass in each sample from each station. Indicator species found would be reported by their proportional occurrence and relevance.

To provide quality control and quality assurance for these studies, Noranda would maintain a permanent reference collection that contains representative samples of all dominant and any indicator taxa of periphyton collected from the monitoring stations. All such non-diatom taxa would be preserved in vials and representative permanent slide mounts made for diatom taxa. Taxonomic identifications in the reference collection would be confirmed by recognized taxonomic experts selected with concurrence of the agencies. This reference collection would be maintained by Noranda through the period of post-operational monitoring. Following this period, the collection would be transferred to a depository selected by the agencies for permanent scientific reference.

Trout Populations

To determine possible changes in fish densities associated with the Montanore Project, fish populations in Libby Creek would be monitored at three-year intervals in a single appropriate stream reach, located near to but upstream from Station L 1. Sampling procedures would include single-pass electroshocking to collect trout from a 300-yard (or 300-meter) reach of stream. The stream reach would be previously blocked by netting at its upstream and downstream limits to prevent fish movement into or out of the sample reach during the sampling. All captured fish would be marked by fin clips and then returned to the stream. The following day, underwater observation techniques would be used to count marked and unmarked fish. Population densities of each fish species captured during the study would be estimated, where adequate sample sizes permit, using an appropriate small-sample, capture-recapture population estimation procedure (e.g., the Seber-Lecren multiple pass method). All captured fish would be examined for overt signs of disease, parasites, or other indications of surface damage.

Bioaccumulation of Metals in Fish Tissue

The aquatic baseline studies revealed that several heavy metals had accumulated in fish collected from Libby Creek. Any increases in cadmium, mercury or lead concentrations in these fish are of high concern due to increasing potentials for future long-term effects to aquatic life, and due to potential risks to wildlife and human consumers of these fish. Additional bioaccumulation of copper, cobalt, and zinc are of relatively low concern as potential risks to fish or consumers of these fish, because these metals have relatively low bioconcentration factors and are essential micronutrients.

Mercury is not native to the Libby Creek watershed. It was brought into the area to use historically in gold mining; its use left the streambed in Libby Creek and tributaries with increased mercury concentrations. Physical disturbance of streambeds during construction and increased surface flows resulting from discharges may increase the mobility and bioavailability of mercury. Lead is found in high concentrations in the barren zone between the two ore zones. Cadmium also is present in very small amounts in the ore proposed for mining. Cadmium, lead, and mercury have been found to accumulate in fish tissues. For these reasons, the agencies are proposing analyzing cadmium, mercury and lead in fish tissue.

Monitoring studies that establish background concentrations and document potential changes in the concentrations of cadmium, mercury and lead in the fish of Libby Creek would continue when mining commences. These studies would include collecting ten cuttbow trout, each greater than four inches in size, and ten adult sculpin from Libby Creek between Stations L1 and L3; this monitoring would be completed every other year. Collections would be completed during the late-summer to early-autumn low-flow period. Tissue samples, including homogenized flesh and skin from each fish, would be analyzed to determine cadmium, mercury and lead concentrations. After the first six years of monitoring, it may be possible to focus this effort only on sculpin if a correlation can be established between the bioconcentration factors for both metals in the "cuttbow" trout and sculpin sampled. This substitution would help reduce sampling loss of cuttbow trout from Libby Creek, and minimize concerns about any possible influence of sampling on population densities in Libby Creek.

Toxicity of Ambient Waters

To assess potential toxic impacts to aquatic life, biological monitoring would include routine laboratory toxicity testing to monitor the potential acute toxicity present in, when such waters are available, (1) mine and adit water that is discharged to the land application disposal area, and (2) decant waters from the tailings pond. For pre- and post-operational monitoring, waters for toxicity testing would be collected during aquatic monitoring in August. During the period of operational monitoring, water for toxicity testing would be collected annually during summer low flows, generally August or September. Additional water collected at these times from Station L10 would provide in-stream reference waters and any water needed for dilution in these toxicity tests.

Should these tests reveal acute toxicity associated with mine, adit or tailings waters, additional instream toxicity studies would be required and conducted at the intervals specified above. The additional instream studies would include waters collected from Station L1, to assess potential toxicities from cumulative upstream sources reaching downstream waters, and from Station L3, to assess the toxicity of waters potentially entering the stream through any subsurface drainages from the land application disposal area. Water from Station L10 would provide water for an instream reference station, and continue to provide dilution waters for the other tests. Toxicity tests using waters collected from the percolation and tailings ponds would determine whether these waters may be a potential source of toxicity found in ambient stream waters downstream of these ponds.

Evaluation of acute toxicity would follow methods presented by Peltier and Weber (1985), or other methods approved by the Montana Water Quality Bureau. Initial toxicity testing would routinely employ early life stages of either cutthroat or cuttbow trout, depending on their availability, and either *Ceriodaphnia* or *Daphnia*. These four taxa are generally comparable in their sensitivities to potential acute toxicity from metals.

The pre-operational toxicity tests would be used to establish appropriate test protocols for later monitoring studies, and establish whether existing

chemical conditions in these creeks are potentially toxic to the test organisms in the laboratory. Substantial uncertainty remains about the ability to complete successfully either *Ceriodaphnia* or *Daphnia* tests in the very soft waters from the Libby Creek drainage. The very low ionic concentrations in these waters can produce excess ion-regulatory stress and death in organisms not adapted to these water quality conditions. Tests using *Daphnia pulex* acclimated to softwater may be more successful than tests using *D. magna*. Also, potentially useful softwater testing protocols using *Ceriodaphnia* are being developed by the EPA in Duluth, Minnesota. When successful invertebrate testing procedures are assured, joint tests using fish and invertebrate species could help to establish the toxicity-response relationship between these species in these test waters. After a satisfactory relationship has been defined, the toxicity tests using fish may be omitted as a future monitoring requirement.

Sampling Trip and Annual Reporting Requirements

Within one week of completing biological sampling in April, August, and October, a brief report would be submitted by Noranda to appropriate review personnel in the KNF, DHES, and Montana Department of Fish, Wildlife and Parks. This report would include brief statements about stream conditions observed at each monitoring station and would alert the review personnel to any marked changes in these conditions.

Within a reasonable time (5 to 7 weeks) after completing each sampling, a report containing the results of all data compiled and analyses completed from the biological monitoring collections would be submitted to the agencies on paper and on computer diskette. (This reporting time period excludes data relating to bioaccumulation studies or those requiring other special chemical analyses by outside laboratories.) A brief report would accompany this data submission, highlighting any new or unusual patterns in the data, with a brief discussion of any known causes for this pattern. These reports would form the basis of the May, September, and November reviews of the monitoring results, as discussed above.

On or before each March 1, Noranda would submit an annual aquatic monitoring report that contains summaries of all aquatic monitoring data collected during the previous year. Each report would also discuss trends in population patterns and evaluate changes in stream habitat quality, based on all data collected to date for the project. Reference to appropriate scientific literature would be included. Guidance on appropriate methods for summarizing monitoring data and analyzing these data for trends are provided by Green (1979), Gilbert (1987), Plafkin et al. (1989), and in Chapter 7 of Wedepohl et al. (1990). Recommendations in these reports can include modifications to increase monitoring efficiency or to provide additional data needs.

Annual Review and Possible Revision of the Monitoring Plan

The monitoring plan for aquatic life is based on a mine operations plan that includes no direct discharge of adit or other treated or untreated mine waters and no withdrawal of surface water for use during mine operations. If any such discharge or withdrawal is included in a future revision of the mine plan, monitoring plan requirements for aquatic life may be revised.

Within one month after Noranda submits the annual report, there would be an annual meeting to review the monitoring plan and monitoring results, and to evaluate possible modifications to the plan. This meeting would include personnel from the KNF, DHES, Montana Department of Fish, Wildlife and Parks, plus Noranda and its representatives. It would be open to other interested individuals. Modifications possible during these reviews could include reductions or additions to the plan. For example, Noranda could be released from being required to use fish in the acute toxicity tests. If trends of increasing metal concentrations in

sediments are detected in the hydrology monitoring program and increasing bioaccumulation of metals occur in fish, new monitoring requirements may be added to evaluate the possible presence of instream sediment toxicity and adverse effects on fish population viability (fish organ testing).

AIR QUALITY

Noranda would install, operate and maintain three air monitoring sites in the vicinity of the mine and facilities (Table B-6). The exact locations of the monitoring sites would be approved by the DHES and meet all the siting requirements in the Montana Quality Assurance Manual including revisions, the EPA Quality Assurance Manual including revisions, and 40 CFR Parts 53 and 58, or any other requirements specified by the DHES.

Noranda would commence air monitoring at the commencement of construction and continue for at least one year after normal production is achieved. The air monitoring data would be reviewed by the DHES and the DHES would determine if continued monitoring or additional monitoring is warranted. The DHES may require continued air monitoring to track long-term impacts of emissions from the facility or require additional ambient air monitoring or analyses if any changes take place in regard to quality and/or quantity of emissions or the area of impact from the emissions. Any ambient air monitoring changes proposed by Noranda must be approved in writing by the DHES.

Noranda would utilize air monitoring and quality assurance procedures which equal or exceed the requirements described in the Montana Quality Assurance Manual including revisions, the EPA Quality Assurance Manual including revisions, 40 CFR Parts 53 and 58, and any other requirements specified by the DHES.

Data Reporting

Noranda would submit quarterly data reports within 45 days after the end of the calendar quarter and an annual data report within 90 days after the end of the calendar year. The annual report may be substituted for the fourth quarterly report if all of the required quarterly information is included in the report.

The quarterly report would consist of a narrative data summary and a data submittal of all data points on AIRS formatted paper input forms, punch cards, disks or magnetic tapes which are compatible with

Table B-6. Proposed air monitoring sites and frequencies.

Location	Site	Parameter	Sampling frequency
Plant area	1	PM-10†	Every third day
Tailings impoundment area (upwind)	2	PM-10	Every third day
Tailings impoundment area (downwind)	3	PM-10 (Co-located§) Wind speed and direction	Every third day Continuous

†PM-10 = particulate matter less than 10 microns
§The requirement for a co-located PM-10 sampler may be waived if Noranda operates a co-located PM-10 sampler at another site
Notes: Trace element analyses would be performed on each filter, including lead, cadmium, arsenic, zinc and copper. The number of elements and frequency of analysis would be reviewed on an ongoing basis.
Data recovery for all parameters would be at least 80 percent computed on a quarterly and annual basis. The DHES may require continued monitoring if this condition is not met.

the DHES's computer system. The narrative data summary would include—

- A topographic map of appropriate scale with UTM coordinates and a true north arrow showing the air monitoring site locations in relation to the mine, the facilities and the general area;
- A hard copy of the individual data points;
- The quarterly and monthly means for PM-10 and wind speed;
- The first and second highest 24-hour concentrations for PM-10;
- The quarterly and monthly wind roses;
- A summary of the data collection efficiency;
- A summary explaining missing data;
- A precision and accuracy (audit) summary;
- A summary of any ambient air standard exceedances; and
- Calibration information.

The annual data report would consist of a narrative data summary containing—

- A topographic map of appropriate scale with UTM coordinates and a true north arrow showing the air monitoring site locations in relation to the mine, the facilities and the general area;
- A pollution trend analysis;
- The annual means for PM-10 and wind speed;
- The first and second highest 24-hour concentrations for PM-10;
- The annual wind rose;
- An annual summary of data collection efficiency;
- An annual summary of precision and accuracy (audit) data;
- An annual summary of any ambient standard exceedance; and
- Recommendations for future monitoring.

The DHES may audit, or may require Noranda to contract with an independent firm to audit, the air monitoring network, the laboratory performing associated analyses, and any data handling procedures at unspecified times. On the basis of the audits and subsequent reports, the DHES may recommend or require changes in the air monitoring network and associated activities to improve precision, accuracy and data completeness.

TAILINGS DAM AND IMPOUNDMENT

The tailings dam stability would be monitored by Noranda both during the operating period and after cessation of mill operations. The monitoring program would consist of visual inspections, piezometer readings, estimates of seepage and topographic surveys. The various aspects of the proposed monitoring are described in detail in the following sections.

The downstream slope and toe of the tailings embankment and saddle, collection and diversion dams (when applicable) would be visually inspected by Noranda on a daily shift basis for evidence of seepage exiting the slope or the downstream toe, and a daily log of observations kept. If seepage is noticed, both the seep location and estimated quantity of flow would be recorded and the project geotechnical engineer immediately contacted for further inspection and recommendation for mitigation measures, if necessary.

If pumps are installed on the pressure relief/seepage collection system, the system would be monitored on a daily shift basis in order to assure proper and continuous operation, and accurate monitoring records would be maintained.

Ground water levels in piezometers installed within the tailings embankment, saddle dam, dam foundations and pressure relief well system would be recorded periodically for evaluation of the embankment stability during and after operations. Piezometer monitoring would be performed by Noranda, with monthly readings made during the first five years of operation. After three years, the monitoring schedule would be reevaluated with respect to the ground water levels and a new schedule established.

The primary purpose for monitoring piezometers would be to maintain a record of ground water levels during disposal operations in order to evaluate the slope stability of the embankments. Ground water level data would be plotted on a continuous graph as soon as is practicable after collection, allowing for development of graphs of ground water levels versus time. Trends in ground water level fluctuations which could impact embankment stability would be reviewed by the geotechnical engineer during each monitoring period in order to determine the potential for instability.

Topographic surveys of semi-permanent monuments located along the downstream toe of the dam would be performed semi-annually by Noranda in order to maintain a record of embankment settlement and movements during operations. Survey monuments also would be installed on the crest of the final dam and monitored during the final years of operation and during reclamation. It is anticipated that the final dam crest would be reached about two years before cessation of operations. Accurate records would be kept of both elevations and coordinates of the monuments. Permanent control points would be established on the final dam crest after cessation of sands deposition. In the event of excessive settlements or horizontal movements, the geotechnical engineer would be notified for review of the survey records and recommendations as required.

The depth and/or elevation of the collection pond water level would be recorded on a weekly basis so that estimates of collected seepage can be developed. Accurate records of the quantity of fluid reclaimed from the collection pond and the decant pond would be kept, including pumping rates and periods of pump operation and shutdown.

Annual reports containing all of the monitoring program data along with summaries of the collected data would be prepared by Noranda and submitted to the agencies.

APPENDIX C— BIOLOGICAL ASSESSMENT

THE KNF submitted a Biological Assessment for threatened or endangered species to the U.S. Fish and Wildlife Service. The Assessment is presented in its entirety in this appendix.

Since the Biological Assessment was submitted, the KNF refined the analysis associated with the transmission line alternatives. The 300 habitat units which would be affected by the proposed transmission line (Alternative 1) mentioned on page 35 have been revised. The proposed transmission line (Alternative 1) would affect 463 habitat units. This information has been transmitted to the U.S. Fish and Wildlife Service.

BIOLOGICAL ASSESSMENT

for

THREATENED AND ENDANGERED SPECIES

MONTANORE PROJECT

Libby Ranger District
Kootenai National Forest

Prepared by:

Al Bratkovich

Al Bratkovich, Wildlife Biologist, Libby District

April 1, 1992

Date

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KOOTENAI NATIONAL FOREST

SUMMARY

SUMMARY OF FINDINGS

Threatened and Endangered Species

Implementation of the proposed federal action will have NO EFFECT on the peregrine falcon and gray wolf; IS NOT LIKELY TO ADVERSELY AFFECT the bald eagle; and MAY ADVERSELY AFFECT the grizzly bear.

Sensitive Species

A separate biological evaluation is being prepared for sensitive plant and animal species. Sensitive species will not be considered in this Biological Assessment.

CONSULTATION REQUIREMENTS FOR THREATENED AND ENDANGERED SPECIES

In accordance with Section 7 of the Endangered Species Act and FSM 2671.4, the Kootenai National Forest is required to request formal consultation with the U.S.Fish and Wildlife Service regarding the determination of potential adverse effects on the grizzly bear; is required to request written concurrence with respect to the determination of potential effects on the northern bald eagle; and is required to request written concurrence with respect to the no effects determination for the peregrine falcon and gray wolf.

NEED FOR RE-ASSESSMENT BASED ON CHANGED CONDITIONS

The findings of this Biological Assessment are based on the best data and scientific information available at the time of preparation. If new information reveals effects that may impact threatened, endangered, or proposed species or their habitats in a manner or to an extent not considered in this assessment; or if the proposed action is subsequently modified in a manner that causes an effect that was not considered in this assessment; or if a new species is listed or habitat identified that may be affected by the action, a revised biological assessment should be prepared.

INTRODUCTION

This Biological Assessment addresses the potential effects of the proposed federal action on all threatened, endangered, and proposed species known or suspected to occur within the area of influence of the proposed action. General life history information on these species is provided in Reel et al. (1989) and is incorporated by reference into this Biological Assessment.

Threatened, endangered, and proposed species are managed under the authority of the federal Endangered Species Act (PL 93-205, as amended) and the National Forest Management Act (PL 94-588). The Endangered Species Act requires federal agencies to ensure that all actions which they "authorize, fund, or carry out" are not likely to jeopardize the continued existence of any threatened, endangered, or proposed species. Agencies are further required to develop and carry out conservation programs for these species. Conservation measures implemented to date for threatened and endangered species by the Kootenai National Forest are on file at the Kootenai National Forest Supervisor's Office.

DESCRIPTION OF PROPOSED ACTION

Noranda Minerals Corporation and their partner, Montana Reserves, have proposed construction of the "Montanore Project" within and adjacent to lands managed by by the Kootenai National Forest (KNF), Libby Ranger District. The Montanore Project is an underground copper-silver mine and associated surface facilities located approximately 18 miles south of Libby, Montana. Noranda has submitted a plan of operations setting forth the construction and operating details of their proposed project. The regulations contained in 36 C.F.R. 228 require the KNF to evaluate the company's proposal and to ensure that the operations are conducted in a manner that minimizes environmental impacts and complies with applicable federal laws. Prior to operating, Noranda must receive approval from the KNF for a plan of operations, and for certain special use permits. They must also receive approval for various other federal and state permits administered by other agencies.

The KNF and three State agencies have prepared a Draft Environmental Impact Statement (1990) and a Supplemental Draft Environmental Impact Statement (1991) for the Montanore Project. These documents address Noranda's proposal and alternatives to their proposal. As presented in the Supplemental Draft EIS, the agencies have selected two preferred alternatives for implementation -- Alternatives 2 and 5. These alternatives propose additional mitigation and compensation, and a different transmission line route than that proposed by Noranda. The combination of these two alternatives is the KNF's proposed action, and is the subject of this Biological Assessment.

The detailed description of the proposed action is presented in the Draft and Supplemental Draft EIS's, which are incorporated by reference into this Biological Assessment. The following is a summary of the proposed action, including mitigation and compensation measures that are an integral part of the proposed action.

Development of the proposed action would disturb six main areas during construction of the project facilities, along with approximately 1.5 miles of new road construction (See Figure 1.).

As part of Alternative 2, Noranda would construct and operate a mine, mill, tailings impoundment, percolation sites, and access roads. The mill and mine adits would be in upper Ramsey Creek, about one-half mile from the Cabinet Mountains Wilderness boundary. An additional adit, currently being constructed on private land along Libby Creek under an exploration permit issued by the Montana Dept. of State Lands (DSL) in 1989, would be used for ventilation. A tailings impoundment would be located in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Excess water would be discharged into two land application disposal sites located between Ramsey and Poorman Creeks, downstream from the mill. Waste rock would be stored at one percolation site, and at the Libby Creek adit area. Noranda would upgrade the Bear Creek Road (No. 278) and two other Kootenai National Forest (KNF) roads (No. 2317 and No. 4781).

As part of Alternative 5, Noranda would construct and operate a 230 KV transmission line extending from Sedlack Park, across the upper Miller Creek drainage, to the Ramsey Creek plant site. A new substation would be constructed at Sedlack Park.

Construction of the project facilities would occur over an approximate 3 year period. The mining operation is planned for an approximate 16 year period. The exact length of mining operations cannot be known at this time. It could be less than that estimated due to poor market conditions, lower recovery rates, or a smaller reserve tonnage than is currently estimated. Conversely, it could extend beyond the 16 year estimate should the market conditions be better, the recovery rates or reserve tonnage be higher, or the production rate be lower than is currently estimated. Regardless, the 16 year production period is a reasonable estimate, and the effects of the proposal as evaluated would not be markedly different if this period were extended by several years.

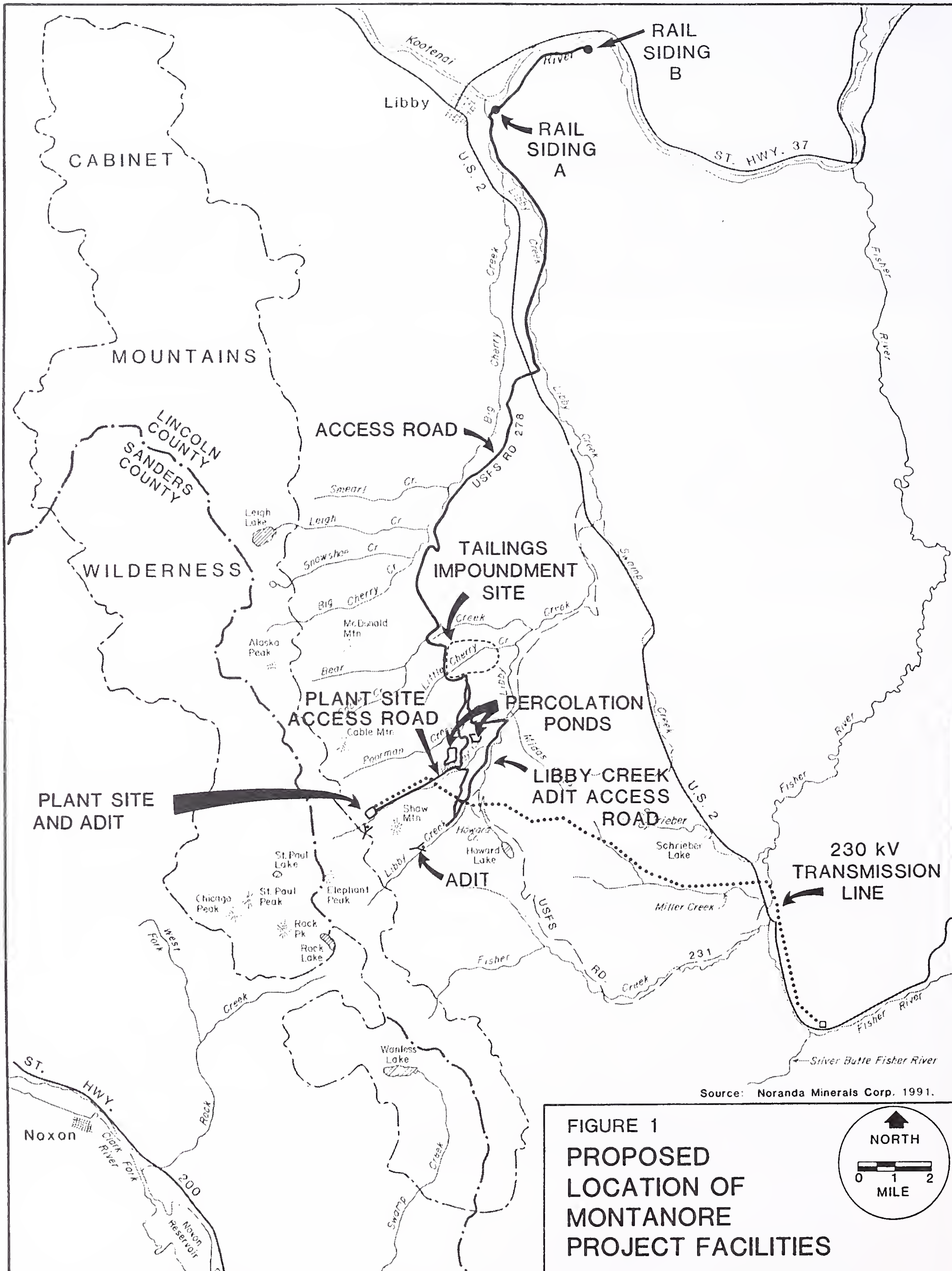


FIGURE 1
PROPOSED LOCATION OF MONTANORE PROJECT FACILITIES

Implementation of the proposed action would include measures to mitigate and compensate for direct, indirect, and cumulative effects on grizzly bears. The mitigation plan is provided in detail in Appendix I. In summary, mitigation includes:

- funding for a full-time wildlife law enforcement position over the life of the project.

- funding for a full-time information and education (I&E) position for the first five years of the project, with equivalent funding provided for the position or for other use, such as research and monitoring, for the remaining life of the project.

- protection of existing grizzly bear habitat now in private ownership or within the influence zones of open roads. Noranda would acquire lands and the KNF would close specific roads in order to replace or protect an equal or greater number of grizzly bear habitat units as that affected by the mining operation.

- seasonal closure of specific road segments to provide security and habitat during the spring season.

- establishment of a Grizzly Bear Management Committee to oversee implementation of the mitigation plan.

- other site specific measures intended to minimize human-bear interaction thereby reducing mortality risk.

- transfer of title of patented claims to the USFS, or maintenance of a conservation easement on patented lands once operations are completed.

SPECIES LIST

The U.S. Fish and Wildlife Service provided a species list of threatened, endangered, and proposed species known or suspected to occur in the Montanore Project area. The list was originally provided on September 28, 1989 and was updated on February 6, 1992.

Table 1. Threatened, endangered, and proposed species known or suspected to occur within the influence area of the proposed action.

Status	Name
Threatened:	Grizzly bear (Ursus arctos horribilis)
Endangered:	Bald eagle (Haliaetus leucocephalus)
	Peregrine falcon (Falco peregrinus)
	Gray wolf (Canis lupus)*
Proposed:	none

* The gray wolf was not included in the U.S. Fish and Wildlife Service list but is included in this BA.

THREATENED AND ENDANGERED SPECIES ASSESSMENT

The following sections provide a summary of the predicted effects of the proposal on Threatened and Endangered species in the Project Area. In evaluating the proposed action on a species and its habitat, the direct and indirect effects of the action and an assessment of cumulative effects of actions in the project area are considered.

Regulations governing interagency cooperation under the Endangered Species Act define "cumulative effects" as the effects of future State or Private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR Part 402). Future Federal actions are subject to the consultation requirements established in Section 7 and, therefore, are not considered cumulative in the proposed action (USFWS, 1991). Cumulative effects of reasonably forseeable Federal actions are addressed in the Final Environmental Impact Statement.

GRIZZLY BEAR

Description of Population and Habitat Status

The project area is within the Cabinet portion of the Cabinet-Yaak ecosystem. The recovery zone for grizzly bears in the Cabinet-Yaak ecosystem is approximately 2600 square miles in size. The minimum viable population requirement of 70 to 90 grizzly bears, established by Shaffer (1978), is the recovery goal for this ecosystem (USFWS,1982). The grizzly population in the Cabinet portion is thought to be less than 15 bears at present, based on 5 years of intensive research by Kasworm and Manley (1988).

Intensive field reconnaissance of grizzly bear habitat was done during the 1981 and 1982 field seasons throughout the analysis area and adjacent Cabinet Mountain Range. The area is divided into separate Bear Management Units, which are used to estimate the effect of various activities upon the bear. The project area is situated within Bear Management Units 5 and 6 (See Figure 2.) Grizzly bear habitat components were delineated and mapped throughout Bear Management Units 5 & 6 by Madel (Christensen and Madel, 1982). All five drainages along the east Cabinet front in Bear Unit 5 are fairly well represented by seasonal habitat foraging components (Table 2). Libby Creek is one of the richest areas in quality and quantity of habitat components in the entire Cabinet Mountains (Ibid).

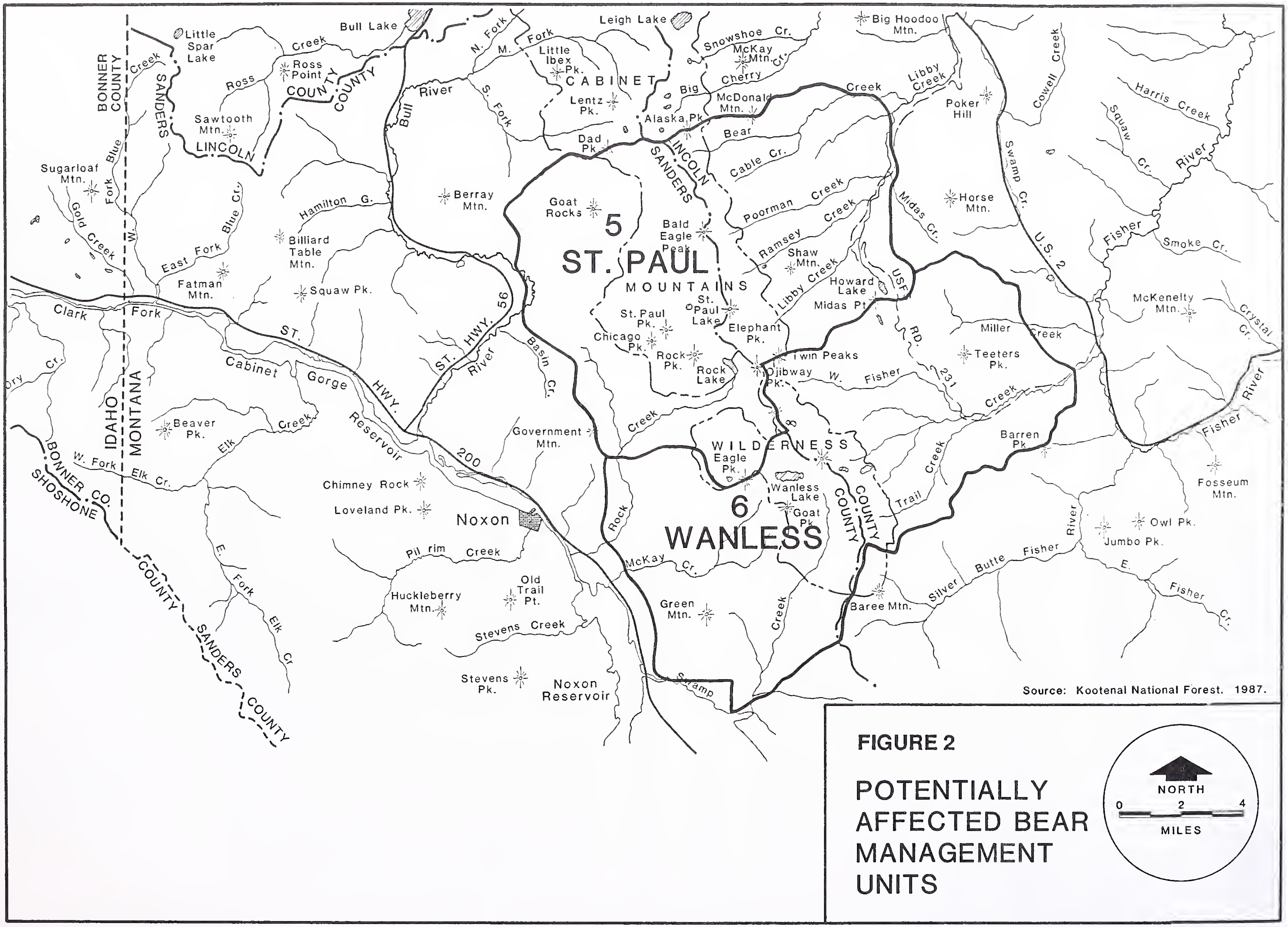


FIGURE 2

POTENTIALLY AFFECTED BEAR MANAGEMENT UNITS

In 1988, habitat components were re-mapped in Bear Units 5 & 6 using a system similar to that described by Christensen and Madel (1982), except both non-forested and forested components were mapped (USFS,1988). This mapping scheme was used in determining habitat units affected by the proposal.

Both grizzly and black bear use continues to be documented in Bear Units 5 & 6, and has been well chronicled by Kasworm (1984a, 1984b, 1985, 1986) and Kasworm and Manley (1987, 1988). Three grizzlies were captured a total of six times along the east Cabinet front during Kasworm's five year study. One capture occurred less than 1/4 mile west of the Libby Creek site on private land where Noranda is presently driving an adit. Ninety-nine different radio locations of three different grizzlies occurred in Bear Unit #5 during the study period. Sixty-six of these locations occurred along the east Cabinet front within five miles of the proposed plant site location (MDFWP Project Files) (See Figure 3).

Kasworm's five year radio-telemetry study generally indicated that the Cabinet Mountains Wilderness served as a core use area for grizzlies (Kasworm and Manley, 1988). Bears appeared to have a pattern of north/south movement along the wildlerness into the Vermilion River area. Grizzlies also moved from denning areas to low elevation sites early in the spring. All three radio-collared grizzlies spent a major portion of the spring on the east side of the Cabinet Mountains, where they used south-facing graminoid sidehill parks and snowchutes in April and May. Bears increased their use of riparian areas in May and June as these sites began to produce succulent vegetation (Ibid). Grizzlies then moved to upper elevations in the summer and fall months, apparently in response to the availability of key bear foods and greater security.

Characteristics of denning sites corresponded closely to those in the Northern Continental Divide Ecosystem (Servheen, 1981; Aune et.al., 1986) and in the Selkirk Mountains (Almack, 1985). Den sites are generally located in remote areas above 5000 feet. Of the six known den sites in the Cabinet Mountains, four were located above 6200 feet in beargrass sidehill parks, one in a timbered shrubfield, and one in a mixed shrubfield rock outcrop. The closest grizzly den site to the proposed project was found 4 miles to the west in the upper Bear Creek basin (personal observation, 1981).

Table 2. COMPONENT ACREAGE BY DRAINAGE FOR BEAR UNIT 5.

DRAINAGE	*SPRING AND SUMMER COMPONENTS IN ACRES	**FALL COMPONENTS
Bear	1080	688
Cable	751	600
Poorman	669	530
Ramsey	181	280
Libby	1440	1286
E.Fork Devils Club	730	865
E.Fork Snake	225	1080
E.Fork Bull	1160	819
Copper Gulch	505	1289
Rock	510	865
W.Fork Rock	65	1310
S.Fork Rock	219	765
TOTALS	7535	10,377

* Spring and summer components include riparian stream bottoms, graminoid sidehill parks, mixed shrubfield/snowchutes, wet meadows, & snowchutes (From Madel, 1982).

** Fall components include mixed shrubfield/cutting unit, mixed shrubfield/burn, and Xete sidehill park (From Madel, 1982).

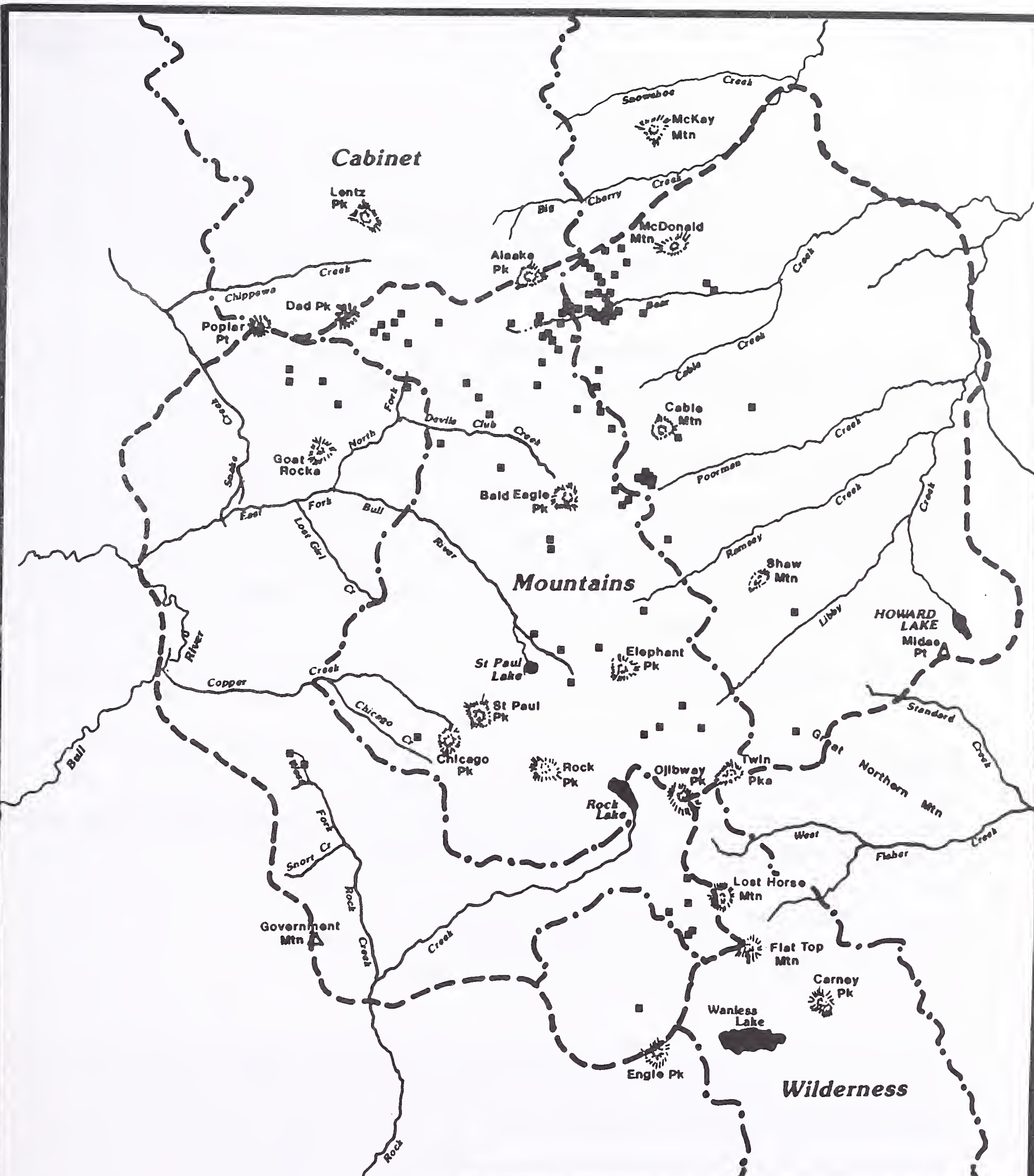


FIGURE 3

Grizzly Bear Radio Locations in Bear Unit No. 5 ▪

1/2" = 1 Mile

Grizzly bears are reported to be fairly secretive in the Cabinet Mountains. Kasworm and Manley (1988) showed that the small sample size they studied tended to use areas where human activity was relatively low. Areas near roads open to motorized vehicles received less use than roads closed to motorized use. Numerous other studies have shown that grizzlies generally respond to human- related activities by avoiding the source of disturbance (Pearson, 1975; Hamer et al., 1979; Zager, 1980; Mace and Jonkel, 1980; and Aune and Stivers, 1983).

There is little evidence to indicate that the present grizzly population within the Cabinet Mountains is habituated to human-related activity. Most recent human/grizzly conflicts have been a result of humans having surprise encounters with bears, generally during the big game hunting season.

Because of the age structure and small size of the population, augmentation of the Cabinet grizzly population is ongoing by the agencies involved with the recovery of the species. This program is currently being pursued as a test to determine the feasibility of population augmentation as a technique in recovering grizzly bear populations. One sub-adult female was transplanted into the Cabinet Mountains in July, 1990. The bear was followed by radio-telemetry for about one year before dropping its collar. Depending on trapping success, an effort will be made to transplant one or two additional female bears into the Cabinet Mountains in 1992.

Analysis of Effects, Including Cumulative Effects

Land and resource managers have recognized that grizzly bears and their habitat can be influenced, positively and negatively, by land use in three basic ways (Weaver, 1986):

1) Direct effect on grizzly bear habitat components
2) Displacement - altering availability of habitat (space)
3) Increased vulnerability to human-caused mortality

Reduced survival of the species can occur due to any effect or combination of effects. Resulting effects can be either direct, indirect, or cumulative. Direct effects are those on-site activities which would alter habitat, displace bears from habitat they normally use, or directly affect grizzly survival. Indirect effects are those caused by a proposed action, but occur later in time or are further removed in distance (occur outside the project area). Cumulative effects are the incremental impacts of the proposed action when added to past, present, or reasonably forseeable future activities in the area. As noted previously, for purposes of this Assessment, reasonably forseeable activities refer only to State or private actions.

The goal for grizzly bear management on the Kootenai National Forest is to provide sufficient quantity and quality of habitat to facilitate grizzly bear recovery. An integral part of the goal is to implement measures within the authority of the Forest Service to minimize human-caused grizzly bear mortalities.

This goal is accomplished by achieving certain objectives relative to grizzly bear recovery (Harms 1990). A number of measures are used to gauge whether the objectives are being met. These measures include non-discretionary Forest Plan standards and guidelines and other discretionary measures. The following analysis describes the potential effects, including cumulative effects of the proposed action by examining how these measures are implemented and, thus, how the objectives relating to grizzly bear recovery are met. The discussion for each objective is divided into two parts. The first part describes the effects of the mineral operation without inclusion of the required compensation and mitigation measures. The second part describes how the mitigation measures would minimize or compensate for the effects on grizzly bears and their habitat in order to achieve the objectives.

Objective 1. **Provide adequate space to meet the spatial requirements of a recovered grizzly bear population.**

Proposed Action Without Required Mitigation - Effects on grizzly bear spatial requirements are measured by compliance with three Forest Plan standards. These standards include spatial requirements within affected Bear Management Units, open road densities within affected Timber Compartments, and displacement areas adjacent to the affected Timber Compartments. For purposes of this assessment, the date September 1, 1992 is used to estimate available space and open road densities. This date was selected because at that time the Libby District will have completed road closures in compliance with Forest Plan standards. One road management option to achieve Forest Plan compliance was presented for public comment in the Draft EIS for the Montanore Project. The Montanore Project, if approved, would not be active until on or after the September 1, 1992 date.

1) This standard, application of the cumulative effects analysis process (Christensen and Madel, 1982), requires that the amount of available bear habitat remains above a minimum threshold of 70 percent within each affected Bear Management Unit (BMU). This figure is referred to as habitat effectiveness or available space. It is calculated by assigning a zone of influence to each activity, and then calculating the area within this zone. Each influence zone represents the distance within which grizzlies are assumed to be affected by the associated activity.

Influence zones and disturbance coefficients were assigned according to procedures described in the Cumulative Effects Analysis Process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems (USFS,1988). A complete and detailed review of this procedure can be found in the Montanore Project Files and is incorporated by reference in this BA.

Displacement of bears currently occupying the project area may occur because of increased human activity in the project area. Disruption of normal behavior patterns could occur. Bears would tend to avoid areas of activity, and consequently would lose available habitat, or habitat would be less effective.

Schoen and Beier (1990) conducted a ten year study of Alaskan brown bears on Admiralty Island within the area influenced by the Greens Creek Mine, which is the largest silver mine in the United States. Their study indicated that although bears seem to remain in their traditional home ranges, they shifted their movements away from active development (Ibid.). They also found a significant (Chi-square test, $P < 0.05$) reduction in brown bear use (day beds) along a stream in the project area within one year after initiation of mine construction (road building activity).

During the construction phase of the Montanore Project, bear use was expected to decrease in an area 0.50 miles around the tailings impoundment, percolation ponds, powerline corridor, and associated access roads. Activities during this period were classified as "Motorized Point Diurnal High-Intensity" or "Motorized Point 24-Hour" (USFS, 1988: p.12). This classification was used since high-intensity motorized activities may well occur simultaneously at all project sites and access roads during the construction period. For the plant site in upper Ramsey Creek, influence zones were extended beyond the 0.50 mile zone to include the entire basin area up to the ridgeline. This is consistent with the assumptions contained in the Displacement Submodel (USFS, 1988: p.10).

During the operation phase of the mine, bear use was expected to decrease in an area 0.25 miles around the tailings pond and associated access roads. No influence zones were assigned to areas surrounding the percolation ponds or powerline corridor since these areas will not be subject to motorized activities on any regular basis. The influence zones for the plant site in upper Ramsey Creek remained the same as those assigned for the construction phase, due to the projected level of activity. Table 3 presents a summary of the amount of total space influenced during both the construction and operation phase in Bear Units 5 & 6.

TABLE 3. Total Space Influenced During Construction and Operation Phases.				
Montanore Project	--BMU 5 (St.Paul)-- (acres) (sq.mi.)		--BMU 6 (Wanless)-- (acres) (sq.mi.)	
Construction Phase	7166	11.2	1458	2.3
Operation Phase	4489	7.0	0	0.0

BMU No. 5 (St.Paul) totals 103 square miles. As of September 1, 1992, approximately 83.0 square miles of space (81% of BMU) would be freely available to bears in BMU 5, as evaluated by the Kootenai National Forest Cumulative Effects Analysis Process (Table 4)(Figures include the influence from the proposed Lost Girl Timber Sale on the Cabinet Ranger District). The proposed project would decrease available space by 11.2 square miles during the construction phase, and 7.0 square miles during the 16 year operation phase. Thus, available habitat would be 71.8 square miles (70% of BMU) during construction phase, and 76.0 square miles (74% of BMU) during operation phase.

BMU No. 6 (Wanless) totals 107 square miles. As of September 1, 1992, approximately 81.5 square miles of space (76% of BMU) would be freely available to bears (Table 4). The proposed project would decrease available space by 2.3 square miles during construction phase, and 0.0 square miles during the operation phase. Thus, available habitat would be 79.2 square miles (74% of BMU) during the construction phase, and 81.5 square miles (76% of BMU) during the operation phase. As Table 4 indicates, this figure would increase to 84.2 square miles (79%) with the proposed mitigation in place (closure of the upper West Fisher road).

TABLE 4. Freely Available (Uninfluenced) Habitat in BMU's 5 and 6.		
	--BMU 5 (St.Paul)-- (sq.mi.) (%)	--BMU 6 (Wanless)-- (sq.mi.) (%)
Total Area	103 sq.mi.	107 sq.mi.
Available space (As of 9/1/92)	83.0 sq.mi. (81%)	81.5 sq.mi. (76%)
With Montanore Project Construction Phase		
- without mitigation	71.8 sq.mi. (70%)	79.2 sq.mi. (74%)
- with mitigation	71.8 sq.mi. (70%)	81.9 sq.mi. (77%)
Operation Phase		
- without mitigation	76.0 sq.mi. (74%)	81.5 sq.mi. (76%)
- with mitigation	76.0 sq.mi. (74%)	84.2 sq.mi. (79%)

2) The second standard sets a maximum open road density of 0.75 linear miles of open road per square mile of habitat within each affected Compartment or other similar 5,000 - 15,000 acre bear analysis area.

The proposed action would affect Timber Compartment No.'s 36, 37, and 43 (See Figure 4). Displayed in Table 5 are open road densities as of September 1, 1992, along with projected open road densities during the construction and operation phase. Forest Plan standards require open road densities at 0.75 mile/square mile or less during periods when bears may be using the area (April 1 to Nov.30).

As Table 5 demonstrates, Compartment No. 37 would have a road density of 0.90 mile/square mile during the three year construction period. This results from opening Road No. 6210 to haul waste rock from the Libby Adit site to the tailings impoundment. This road would be closed at the end of the construction period. The road density in Compartment No. 43 would be 1.20 miles/square mile during powerline construction in the North Fork of Miller Creek. This results from opening Road No. 4725.

TABLE 5. Road Density Projections for Compartments 36, 37, and 43.

COMPART-MENT	AS OF 9/1/92	WITH MONTANORE	
		Construction	Operation
#36	6.2 miles/ 9.3 sq. mi. = 0.67	0.67	0.67
#37	20.4 miles/ 27.1 sq. mi. = 0.75	24.4/ 27.1 = 0.90	20.4/ 27.1 = 0.75
#43	5.8 miles/ 7.7 sq. mi.= 0.75	9.5/ 7.7 = 1.20	Spring=0.13 Summer/Fall =0.75

3) The third Forest Plan standard provides that a 5,000 - 15,000 acre displacement area (an area meeting all standards and containing no major activities) be provided adjacent to each Compartment or analysis area containing a major activity.

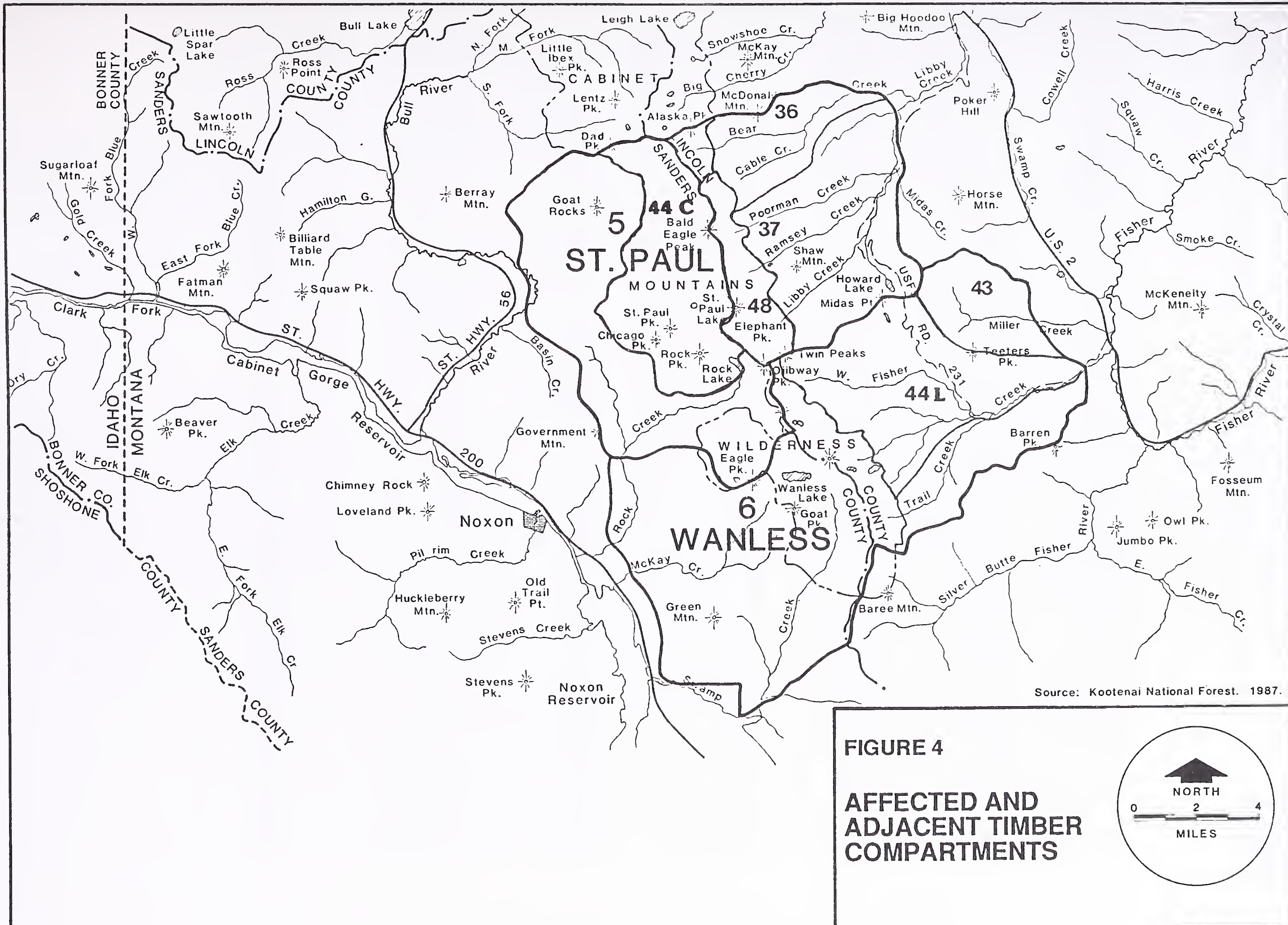
Compartment No. 48, on the Libby District, and No. 44, on the Cabinet District, are two compartments within wilderness that comprise a 19,000 acre (30 sq.mi.) displacement area immediately west and adjacent to Compartments No. 36 and No. 37 (Figure 4). These two compartments have no major activity planned in the forseeable future. Compartment No. 43, where a portion of the powerline would be constructed, lies adjacent to Compartment No. 44 (Libby District) which would provide a 13,000 acre (21 sq.mi.) displacement area during powerline construction.

<u>Proposed Action With Required Mitigation Measures</u> - The analysis shows that the proposed action, without the required mitigation, would not meet Forest Plan standards for open road density during the construction period in two Timber Compartments (No.'s 37 and 43), but would meet these standards during the operating period. No measures are included in the proposed action to meet the road density standards during the construction period.

The analysis also shows that the proposed action, without the required mitigation, would meet the Forest Plan standards of maintaining available space at or above the 70 percent threshold for both affected BMU's, and would provide adequate displacement areas adjacent to the three affected Timber Compartments.

Although not required in order to meet Forest Plan spatial standards, the mitigation measures required in the proposed action would provide additional space available for bears, either through direct replacement or by protecting private lands from being developed. Replacement would occur by implementing road closures. Protection would occur through purchase of private lands or conservation easements. Both of these actions would have additional benefits, discussed elsewhere in this assessment. These include replacement or protection of habitat, and reduction in mortality risk. Road closures and the habitat acquisition program are presented in detail in Appendix I.

Yearlong closure of the West Fisher road system (Road No.'s 6746, 6744, and 6746 C) would provide approximately 2.7 square miles of additional space within the affected BMU 6. As a result, the amount of available space within BMU 6 would be increased to a total of 81.9 square miles (77%) during construction, and 84.2 square miles (79%) during operations (Table 4).



Source: Kootenai National Forest. 1987.

FIGURE 4

AFFECTED AND ADJACENT TIMBER COMPARTMENTS

Seasonal closures (April 1 to June 30) of the South Fork Miller Creek Road No. 4724, the Midas Creek Road No. 4778, and the Deep Creek Road No. 4791, would provide an additional 7.5 square miles of space during the spring period.

The land acquisition program would provide additional space available for bear use. The specific amount and location of this space cannot be known at this time. The Management Committee established for this project (see Appendix I) must first priortize desirable lands and direct their purchase. These lands would be within the affected BMU's, along the east side of the Cabinet Mountains, or elsewhere within the Cabinet portion of the ecosystem. The Libby Ranger District has established a priority list for lands to be acquired within bear habitat along the east Cabinet front. This list will be available to the Management Committee. Land acquisition may increase or protect approximately 2000 acres of space, based on the number of acres estimated to replace habitat under the acquisition program.

The proposed road closures would provide important displacement areas for grizzly bears, particularly during the critical period after den emergence. This is discussed in detail under Objective 2.

Objective 2. **Manage for an adequate distribution of bears across the ecosystem.**

Proposed Action Without Required Mitigation - Grizzly bear habitat on the Kootenai National Forest is evaluated according to the Bear Management Unit (BMU) concept (Christensen and Madel, 1982) for purposes of managing cumulative effects of human activities. This management concept potentially provides for an adequate distribution of bears by delineating management units (averaging about 100 square miles) with specific land management guidance to ensure compatibility with grizzly bears. BMU's are further broken down into smaller Compartments or analysis areas (5,000 to 15,000 acres in size) for evaluation and application of measures to ensure adequate distribution of bears. Each compartment/ analysis area in Bear Units 5 & 6 was analyzed for three standards to determine if the distribution objective is being met.

1) Opening size -- This standard was developed as a method of estimating effects from timber sales. It requires that clearings, either individually or in combination with existing unrecovered units or natural openings, should be $\leq$40 acres (big game summer range) or $\leq$20 acres (big game winter range).

The Montanore Project would involve four separate clearings which would exceed the standard for opening size in bear habitat. Approximately 729 acres would be cleared for the tailings impoundment (USFS, 1990: p.208), with an additional 265 acres cleared for the borrow areas (USFS, 1991: p.12). These sites would be cleared of vegetation prior to impoundment construction (USFS, 1991: p.20). The plant site would require 45 acres of clearing, and percolation pond No. 1 might require another 58 acres. All openings would have some internal points greater than 600 feet from cover. The powerline would require a linear clearing 100-200 feet wide and totaling about 6.4 square miles in bear habitat; however, no internal point would be further than 600 feet from cover.

2) Movement corridors -- The standard requires unharvested corridors $\geq$600 feet in width should be maintained between proposed clearings and between proposed and unrecovered existing harvest units or natural openings.

The powerline would create corridors less than 600 feet from existing cutting units lacking cover. This would be particularly true in upper Ramsey Creek where the powerline would run adjacent to four clearcuts. However, due to the small size of the existing units, and the narrow opening created by the powerline, no point within a given unit or the line corridor would be greater than 600 feet from cover. Thus, the intent of this standard would be met.

3) Seasonal components -- The standard requires that proposed activities be scheduled to avoid known spring habitats during the spring period (April 1 to June 15) and known denning habitats during the denning period (October 15 to April 15).

Spring habitat is very important to grizzly bears in this area. Research conducted by the MDFWP (1983-1988) resulted in the capture of three grizzlies a total of six times along the east Cabinet front, all during the spring period of April through June (Kasworm & Manley,1988). These were the only grizzlies captured during the five year study even though trapping occurred throughout the Cabinet Ecosystem, and at different times of the year. Kasworm (pers.comm., 1991) indicated that trapping and monitoring results provided strong evidence to support the conclusion of grizzly use along the east front during the spring.

Due to the operation's yearlong activity, the standard of avoiding spring habitat during the period April 1 to June 15 would not be met.

Also, although no proposed activity would occur directly within denning habitat, blasting at the adit portal in upper Ramsey Creek during the denning period (Sept.15-Nov.30) could affect bears seeking den sites in the upper basin area. Research by Schoen and Beier (1990) on Admiralty Island documented the movement of den sites by 6 female brown bears further away from the area influenced by the Greens Creek Mine. The mean distance these bears denned from the mine site the first year of observation was 2.1 miles. They denned significantly ($P < 0.05$) further away from the mine site the next year with a mean distance of 7.3 miles.

Once construction of the Ramsey Creek adits progresses underground, the noise from blasting should have little or no impact on bears seeking den sites in the upper basin area.

4) Open-road densities -- Refer to discussion under Objective 1.

5) Displacement areas -- Refer to discussion under Objective 1.

<u>Proposed Action With Required Mitigation</u> - The analysis shows that the proposed action, without required mitigation, would not meet standards usually applied to timber sales for opening size. It also would not meet standards for seasonal components. There is no way to meet the opening size standard considering the size of clearing required for certain facilities. Although spring components would be unavoidably affected by the operation, several measures would be employed to compensate for these effects. These measures consist of selective road closures, habitat acquisition, and a seasonal (spring) restriction on powerline construction in the Miller and Midas Creek drainages. The road closures would have a beneficial effect on low elevation spring habitat along with higher elevation summer/fall habitat. Acquisition of private lands would help protect spring habitat that otherwise might be developed. No motorized activity associated with powerline construction will be permited within bear habitat in the Miller and Midas Creek drainages during the April 1 to June 15 period. This will enable the proposed spring road closures in Miller and Midas Creek to remain functional throughout both the construction and operation period. The road closure and habitat acquisition programs are described in detail in Appendix I.

Kasworm (1989) analyzed radio locations from 3 grizzly bears in the Cabinet Mountains to determine the effects of roads on seasonal habitat use patterns from 1983 to 1988. He concluded that mitigation for mineral and timber extraction in grizzly bear habitat should utilize road closures during and after the project to control the volume of activity (Ibid.).

Kasworm and Manley (1988) state that grizzly use in the Cabinet Mountains was reduced 78 percent from that expected in the spring in areas adjacent (up to 0.28 mile) to open roads. In southeastern British Columbia, grizzly bears were found to use areas within 328 feet (100 meters) of roads significantly less than expected, which was equivalent to a habitat loss of 58% within these zones (McLellan and Shackleton, 1988).

Three segments of road would be closed on a yearlong basis, and three would be closed seasonally (April 1 to June 30) during the life of the project (Figure 5). In addition, the closure period on the upper Bear Creek Road #4784 would be extended by 45 days, becoming effective on September 1 annually, rather than on the present October 15 closure date. Road closures would take effect prior to construction start-up. These road closures would provide several benefits. They would immediately benefit the bear by providing additional security adjacent to the affected area, especially during the critical period following den emergence. They would replace space lost by the operation. They would provide additional habitat, including important spring components, that otherwise would not be fully available to bears. Closures would also increase security in the Midas and Miller Creek drainages, where an abundance of graminoid sidehill park spring components occur. Perhaps even more importantly, the closures would reduce the risk of human-caused mortality, especially during the spring black bear hunting season.

Habitat components located along closed roads, and the geographic location of these roads, would be similar to the components and land area impacted by the mine. Road closures would help off-set effects on low elevation spring range sites during both the construction and operation periods.

The West Fisher road system (Road No.'s 6746, 6744, and 6746 C) would be closed on a yearlong basis. Spring components currently within this influence zone consist of 60 acres of riparian streambottom, 83 acres of graminoid park, and 147 acres of south-facing mixed shrubfield components.

Seasonal closures would be enacted over the project life for the South Fork Miller Creek Road No. 4724, the Midas Creek Road No. 4778, and the Deep Creek Road No. 4792. These roads would be closed from the period April 1 to June 30 each year. These three roads would provide 7.5 square miles of additional space during the spring period, and would affect 660 habitat units. These components are similar to those being affected by development activities associated with the low elevation areas in the Little Cherry Creek area, and would mitigate for 562 habitat units impacted from all construction activity influence zones (not including the powerline), and 33 habitat units impacted from tailings pond and road reconstruction influence zones.

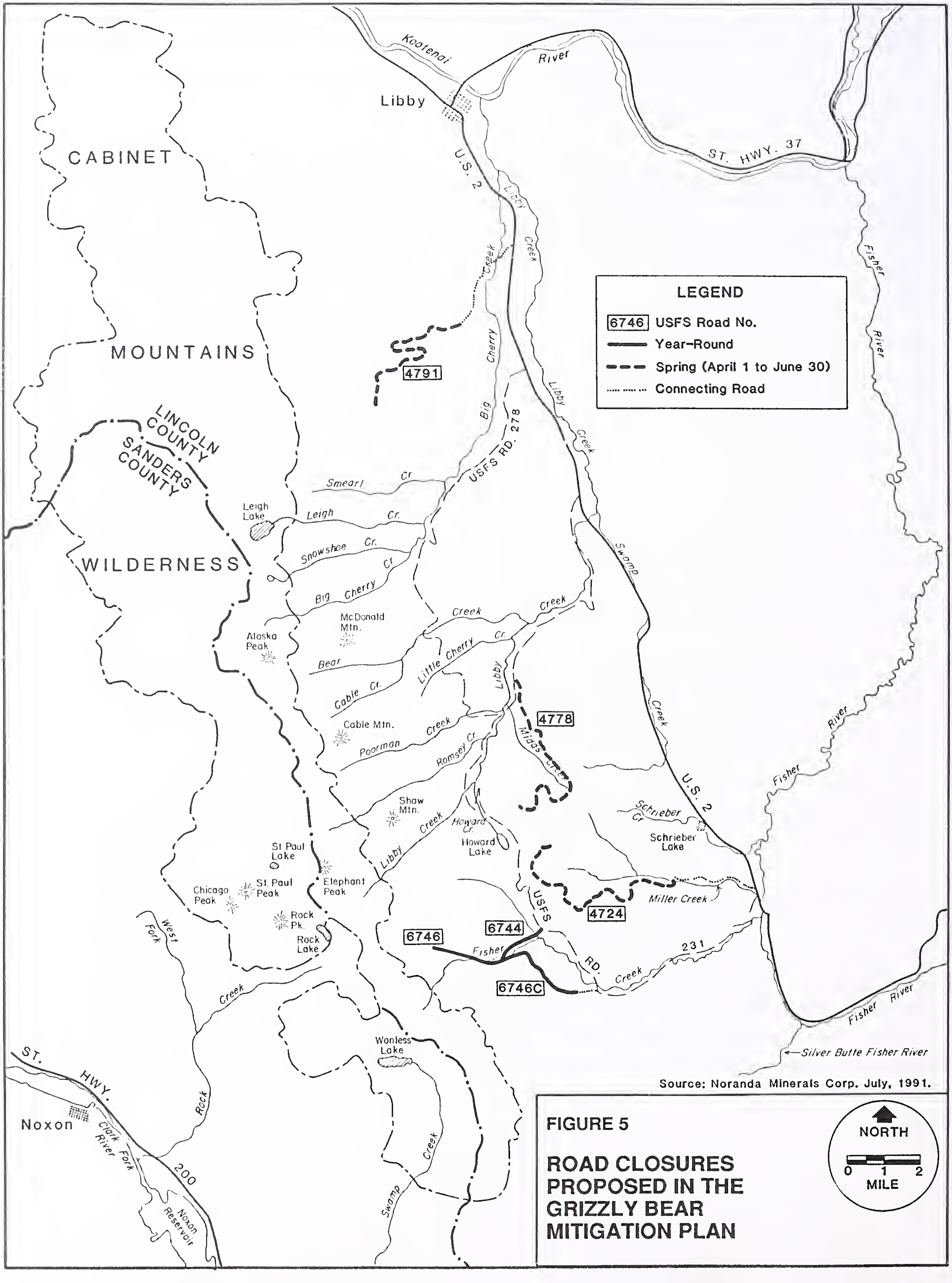


FIGURE 5

ROAD CLOSURES PROPOSED IN THE GRIZZLY BEAR MITIGATION PLAN

The Miller Creek and Midas Creek road segments occur on the very eastern edge of delineated grizzly habitat along the east Cabinet front, and as mentioned, are associated with an abundance of recognized spring habitat components such as the graminoid sidehill park complexes in Miller Creek and on Horse Mountain (Madel, 1982). These areas are potential displacement areas for bears in the spring in the vicinity of the project site. Food habits data from grizzlies in the Cabinet Mountains during the 1983-1987 period indicated that graminoids dominated the diet (80 percent importance) during May (Kasworm and Manley, 1988). These two areas have over 1000 acres of graminoid park habitat.

The Deep Creek area receives heavy use by black bears in the spring (pers.observation; MDFWP trapping record files). This area would provide a relatively secure area in the spring more removed from the project site.

Closure of the upper Bear Creek Road #4784 annually on September 1 will provide greater security for grizzlies during the fall black bear hunting season, which normally opens the first weekend in September. Kasworm and Manley (1988) describe in detail the value of the Bear Creek drainage to bears, which was one of the most heavily used areas by grizzlies on the basis of radio locations. All three radio-collared grizzlies used Bear Creek as part of their core spring-summer range (Ibid.).

Land acquisition, as required by the proposed action, would protect spring habitat on private lands. These lands might otherwise be developed in a manner that precludes bear use. The exact location and amount of spring habitat that would be acquired is unknown at this time. It would depend on the priorities for land acquisition established by the Management Committee.

Objective 3. <u>**Manage for an acceptable level of mortality risk.**</u>

<u>Proposed Action Without Required Mitigation</u> - Kasworm (1986) and Kasworm and Manley (1987, 1988) have identified human-caused mortality as one of the main factors in the demise of the grizzly in the Cabinet Ecosystem. At a minimum, 61 known mortalities were documented from 1950 to 1990 (Kasworm and Thier, 1990). During the 1980's, most documented grizzly bear mortalities in the Cabinet-Yaak ecosystem have resulted from interactions between bears and big game hunters (Ibid.). Two of the three grizzlies radio-collared along the east Cabinet front were shot by hunters within five months of capture, illustrating the pressure of human-induced mortality on the population. One of the bears eventually recovered after receiving two body wounds from a 30.06 caliber rifle (Kasworm and Knick, 1989). Shooting mortality is of primary and immediate concern for the recovery of the Cabinet grizzly population (Ibid.). In this regard, increased law enforcement along with better public education and awareness is of vital importance to grizzly recovery in the Cabinet-Yaak Ecosystem.

The direct potential for increased mortality to grizzly bears exists as a result of the proposed project. Increased activities anywhere in grizzly habitat increases the potential for human-induced mortality. Grizzly mortalities could result from bears being illegally shot by employees. Several illegal shootings of big game animals occurred in the project area by subcontractor's for Noranda in 1990 (Montana Dept.Fish,Wildlife,& Parks, law enforcement files). A total of 14 seperate charges were brought against 5 individuals for illegally poaching 11 big game animals (Ibid). One deer appeared to have been shot and left as bear bait during the spring bear season (pers.comm., Mack Long, 1992). Three additional cases are still under investigation.

Increased availability of artificial attractants (especially garbage) could also be a direct effect of the project. This too could lead to bear mortality.

Indirect or off-site effects are those that occur away from the project site or later in time. Indirect effects from the Montanore Project could result from increased recreational activity in bear habitat. This raises the potential for increased human/grizzly conflicts which can result in grizzly mortality. Grizzly bear avoidance of high quality habitat near trails may also lessen the opportunity for bears to obtain food, and also increase intraspecific competition by further forcing bears into remote habitat (Kasworm and Manley,1989).

The demand for recreation around the project site is expected to increase along the east Cabinet front as a result of the project (USFS, 1990: pp.243-244). Along with the increased awareness of locals hired by Noranda of the many recreational amenities adjacent to the project facility, offsite recreational activities can be expected to increase. A projected 2 percent population growth is expected to occur in the Libby area as a result of the project (USFS, 1990: p.266). Trails and roads that provide access to primary attractions such as lake basins or scenic viewpoints receive a large percentage of the total use in the Cabinet Mountains Wilderness and surrounding roaded areas (Kootenai NF, Libby Ranger District recreational use files,1990). These routes would likely receive increased use. With more people entering grizzly habitat during spring, summer and fall months, certain areas would become less secure habitat. Martinka (1982), reported that in Glacier National Park, the number of bear confrontations appeared to be closely correlated with park visitations for the 1951-80 period. As more people/bear interactions occur over time, the potential for human-induced mortality increases due to removal or illegal kills (Ibid.). The increased recreational activity occurring in bear habitat as a result of the project could extend beyond the life of the mine, although it is extremely difficult to project the level of activity and associated impacts to the bear.

The powerline would open up new areas for future recreational use (USFS, 1990: p.244), especially due to new access roads. These proposed roads would continue to make previously non-roaded areas in upper Miller Creek more accessible to hunters and other recreational users (Ibid: p.247). Road construction needed for the N.F.Miller Creek transmission line would encompass 31 acres (Ibid: p.241). McLellan (1988c) indicates that resource extraction industries that develop road networks can have a significant effect on the causes and rate of grizzly bear mortality.

Patenting of mill site claims by Noranda could lead to development of these lands in a manner detrimental to the grizzly bear after mine closure and reclamation. Although it is not certain what lands, if any, Noranda might patent, they may be entitled to patent areas such as the plant site in Ramsey Creek and the tailings impoundment in the Little Cherry Creek drainage. Patenting can have a long term adverse effect on bears by increasing the potential for future site occupancy, and greatly restricting options for road access management. McLellan (1988), in his nine year grizzly study in northwest Montana and southern British Columbia, emphasizes the potential problems that can result to grizzlies if these two factors are not properly controlled after resource extraction has occurred. Numerous examples can be found along the east Cabinet front where road management is greatly encumbered due to patented mining claims.

As mentioned, grizzly bear vulnerability to human-caused mortality is partially a function of habitat security. Therefore, mortality can be partially managed by the application of standards which are designed to maintain or enhance habitat security. These standards have previously been discussed for objectives 1 and 2: 70 percent habitat effectiveness threshold, movement corridors, seasonal components, and open-road density.

<u>Proposed Action With Required Mitigation</u> - A number of mitigation measures would be used to reduce mortality risks associated with the direct, indirect, and cumulative effects of the operation. These include hiring of law enforcement and information/education positions, seasonal and yearlong road closures, and other measures designed to minimize the potential for human-bear interactions. These mitigation measures are described in detail in Appendix I.

The new law enforcement position would help deter illegal killing of grizzly bears in the area. The information and education position would increase public awareness, and help to increase acceptance and support of grizzly bear management. Public attitudes are a major part of the success or failure of grizzly bear recovery efforts (USFWS, 1990). It is crucial to the recovery effort that people understand reasons for actions in order to have a favorable attitude toward the bear (Ibid.)

The management of roads is the most powerful tool available to balance the needs of bears with the activities of humans (USFWS, 1990). The closure of the upper West Fisher road system would provide greater security to bears on a year-round basis. McLellan and Mace (1985) found that a disproportionate number of human-caused grizzly mortalities occurred near roads. Aune and Kasworm (1989) reported that 63% of known human-caused grizzly deaths on the east front of the Rocky Mountains occurred within 0.6 miles of roads, including 10 of 11 known female grizzly deaths.

Closure of the upper Bear Creek Road #4784 on September 1 would provide greater security to grizzlies during the fall black bear season by reducing the potential for illegal or mistaken identity kills. Only one female grizzly was captured and radio-collared in the Cabinet Mountains during a five year study from 1983 to 1987, and that bear used the Bear Creek drainage extensively during the 5 year monitoring period (Kasworm & Manley, 1988). Because grizzly bear offspring, especially female offspring, tend to occupy habitat within or near the home range of their mother after weaning (USFWS, 1990), increased security from this extended closure could enhance habitat effectiveness for many grizzlies whose home ranges encompass the drainage.

The spring road closures previously discussed would decrease vulnerability to human-caused mortality by restricting motorized use, especially during the spring black bear hunting season. Driving open roads is the primary hunting method used along the east Cabinet front during the spring season. Hunting districts 103 and 121 encompass the Cabinet Mountains on the north and south, respectively. In 1986, district 103 had the greatest black bear harvest for the state of Montana, and district 121 had the greatest number of hunter days for black bear of all districts in Montana (Kasworm and Manley, 1988).

Any mining and mill site claims that Noranda might patent as a result of the Montanore Project will be managed for grizzly bears subsequent to the mining operation. This is to ensure that these lands are not developed after the mining operations contrary to grizzly management objectives. Patented mining and mill site claims can be handled in one of three ways detailed in Appendix I.

Other measures to reduce the direct increase in mortality risk from the operation include restricting public motorized travel in the upper Ramsey Creek drainage, setting speed limits along access roads to minimize the amount of road-killed deer that could attract bears, removing road-killed animals on a daily basis to reduce the potential for human-bear interaction, prohibiting firearms from being carried within the permit area, and the use of bear proof containers for garbage.

Objective 4. **Maintain/improve habitat suitability with respect to bear food production.**

Proposed Action Without Required Mitigation - The Montanore project during the operation phase would have a direct effect on grizzly bear habitat by physically altering approximately 1200 acres, and also influencing an additional 3000 acres. An assessment to determine actual habitat quality of all areas affected was made by calculating habitat units using procedures described in the Selkirk/Cabinet-Yaak Cumulative Effects Analysis Process (USFS,1988). Habitat unit values are essentially a function of seasonal food values and edge values. The seasonal food value is a relative value reflecting the availability and importance of known bear foods. The edge value is based on the assumption that ecotones are more valuable to bears than discrete habitat components; therefore, increased values result from a significant edge effect (Ibid.). A complete description of the method used to calculate habitat unit values can be found in the Montanore Project File, which is incorporated by reference into this assessment.

Many researchers have documented the general relationships between food availability and reproductive potential (Aune 1985, Bunnell and Tait 1981, Blanchard in press, Knight et al. 1986, Nagy and Russell 1978, Reynolds and Hechtel 1984, Stringham in press). Habitats with high value food sources produced females with greater body weight, which is highly correlated with increased reproductive parameters. Aune and Stivers (1985) noted that along the Rocky Mountain East Front, litter sizes south of the Sun River (n=3) were smaller than those in the more productive habitat north of the Sun River (n=16). Blanchard (in press) analyzed 8 North American grizzly populations and found that females in those populations with reliable, high value foods during summer and fall attained greater size, produced cubs earlier, and had larger litters than females with relatively low value foods available to them. Similarly, Stringham (in press) found that body size was a good predictor of the mean rate of reproduction and, probably, juvenile survival. For ten grizzly bear populations, variations in body weight corresponded strongly with variations in productivity; i.e. number of cubs per adult female per year (Ibid.).

Maintenance of high value foraging sites is essential in the Cabinet Mountains, especially during the spring period. Spring components outside the upper canyons are the few habitat sites phenologically available to bears in April and May along the east Cabinet front (Madel, 1983).

TABLE 6. Habitat Units (by season) Affected by the Montanore Project (Operation Phase).

PROJECT COMPONENT	MAP # **	DISTURBANCE COEFFICIENT		*HABITAT UNITS		MULTIPLIER	*HABITAT UNITS INFLUENCED	
		crnt	Prjt	Spg	Fall		Spring	Fall
Ramsey Plant Site	#1	0.0	1.0	53	57	1.0	53	57
Ramsey Plant Site (1/2 Mile Zone)	#2	0.0	0.1	236	278	0.9	212	250
Ramsey Plant Site 1/2 Mile to 1 Mile Zone)	#3	0.0	0.5	410	505	0.5	205	253
Ramsey Plant Site 1 Mile to Ridgeline Zone)	#4	0.0	0.81	126	155	0.2	25	31
Upper Ramsey Road 1/4 Mile Influence Zone)	#5	0.0	0.3	110	106	0.7	77	74
Libby Adit	#6	0.5	0.5	28	24	0.5	14	12
Tailings Pond	#7	0.3	1.0	104	82	0.3	31	25
Interior Tailings Pond Area	#7A	0.0	1.0	14	12	1.0	14	12
Road Influence Zone	#8	0.0	0.3	1	1	0.7	1	1
Road Influence Zone	#8A	0.0	0.3	6	5	0.7	4	4
Road Influence Zone	#8B	0.0	0.3	28	27	0.7	20	19
Percolation Pond #1	#9	0.3	1.0	36	28	0.3	11	8

TABLE 6. Habitat Units (by season) Affected by the Montanore Project (Operation Phase).(Continued)

PROJECT COMPONENT	MAP # **	DISTURBANCE COEFFICIENT		*HABITAT UNITS		MULTIPLIER	*HABITAT UNITS INFLUENCED	
		crnt	Prjt	Spg	Fall		Spring	Fall
Perc. Pond #1 (Interior)	#9A	0.0	1.0	3	3 1.0		3	3
Percolation Pond #2	#10	0.3	1.0	28	20	0.3	8	5
Perc. Pond #2 (Interior)	#10A	0.0	1.0	27	20	1.0	27	20
Borrow Pit #1	#11	0.3	1.0	5	4	0.3	2	1
Borrow Pit #1 (Interior)	#11A	0.0	1.0	2	1	1.0	2	1
Borrow Pit #2	#12	0.3	1.0	8	6	0.3	2	2
Borrow Pit #2 (Interior)	#12A	0.0	1.0	32	26	1.0	32	26
Tailings Pond Influence Zone	#13	0.0	0.1	10	4	0.9	9	4
Tailings Pond Influence Zone	#13A	0.0	0.1	1	1	0.9	1	1
TOTALS				1268	1365		753	808
Average Habitat Unit Value				1317			781 (785)	

* All habitat unit figures are rounded up to the nearest whole number. The 781 unit figure is based on an total average of spring and fall values. The 785 unit figure is based on an average of individual components.

** Corresponding map has been sent directly to USFWS.

Crnt = current Pjct = Projected Spg = Spring

Habitat units were calculated for all disturbed sites and all areas influenced. Disturbance coefficients were then assigned, which reflect the degree to which habitat within each influence zone remains effectively usable by bears. A disturbance coefficient of 0.5 is interpreted to mean that the area's ability to support bears is 50% of potential; thus, either 50% of the bears have been displaced, or all bears can use the area only 50% of the time, or any combination (USFS, 1988: p.10). A disturbance coefficient was then multiplied against the habitat unit average to determine actual habitat unit values affected by the disturbance (Table 6). A complete narrative describing this process is available in the Montanore Project File.

A total of 785 habitat units were calculated as being affected by project activities during operation phase (Table 6). As mentioned previously, 562 additional habitat units would be affected during construction phase on low elevation spring range sites, and about 300 habitat units affected in Miller Creek and Midas Creek during the period of powerline construction.

Of the total habitat units affected during the operation phase, approximately 80% (619) occur in the upper Ramsey Creek basin area. This is a basin extending into the main core of the Cabinet Wilderness. These upper basin areas along the east Cabinet front contain an abundance of recognized foraging components utilized by bears during all seasons of the year, particularly summer and fall (MDFWP files, documented radio locations of three grizzlies from 1983-1987).

Approximately 20% (166) of the habitat units affected during operations occur on low elevation sites along the east front. These sites are generally more heavily timbered and do not contain the diversity or density of recognized high value foraging components existing in the upper basins of the main Cabinets (Madel, 1982). Research by Kasworm and Manley (1988) has shown some use of these areas by grizzlies in the spring, with little documented use in summer or fall. All additional habitat units affected during construction also occur on these low elevation sites.

A total of 133 habitat units encompassing about 1500 acres (See Table 7) would be physically altered due to construction of mine facilities such as the tailings pond, plant site, percolation ponds, and borrow pits. This equals approximately 17% of the total habitat units affected by the project. The additional 652 habitat units affected encompass about 3500 acres, and would be influenced by project activities but would not be physically altered.

TABLE 7. Acreage of Habitat Components Physically Altered by the Montanore Project.

FACILITY	COMPONENT **	ACREAGE
Plant Site	Mixed Shrubfield	17
	Coniferous Forest	28
Tailings Impoundment	Marsh	2
	Riparian Streambottom	2
	Coniferous Forest	659
Borrow Pits	Coniferous Forest	255
Percolation Pond #1	Coniferous Forest	236
Percolation Pond #2	Mixed Shrubfield	14
	Coniferous Forest	83
	Dry meadow	118
Libby Creek Adit	Riparian Streambottom	16
	Coniferous Forest	37
	Total	1467

** Habitat components as described in USFS (1988).

Proposed Action With Required Mitigation Measures - The proposed action includes mitigation measures intended to replace or protect an equal or greater number of habitat units that are affected by the operation. This would be accomplished through road closures and a habitat acquisition program. The road closures would compensate for approximately 32% (248 HU's) of the affected habitat units. The remaining 68% (537 HU's) would be acquired through purchase of private lands or conservation easements. The road closures would be implemented prior to construction activities and would extend throughout the life of the project. The land acquisition program would be completed within a six year period, with at least one-half of the purchases made within the first three years. A Management Committee would direct the land acquisition program, and would determine the effectiveness of road closures. The details of this program are provided in Appendix 1.

Consideration was given to using habitat acquisition as the only compensation measure for replacing or protecting habitat units. Initially, road closures were not included as part of this mitigation. This was in part due to concerns about public sensitivity about such closures, and the consequent negative public attitudes toward grizzly bear management. While recognizing this sensitivity, road closures were made part of the proposed action because they would provide significant overall benefit to grizzly bears. Road closures are a necessary part of the mitigation plan because: 1) They immediately provide replacement habitat adjacent to the affected area, and this habitat provides components similar to those affected by the project. 2) The most desirable lands targeted for acquisition may not be available. Therefore, acquisitions might actually occur in more marginal habitat, or in areas further removed from the project impacts. 3) Lands available for purchase may already be effective habitat utilized by bears. Thus, even though the parcels are acquired, the gains would be more long-term in nature, and little or no short-term gain would be realized.

Under the proposed action, the West Fisher road system (Road No.'s 6746, 6744, and 6746 C) would be closed on a yearlong basis to partially compensate for habitat units affected by the project. Approximately 215 habitat units would be gained by this closure along with 2.7 square miles of space. The 215 habitat units would be applied toward the total habitat units which need to be replaced (approx. 28% of the total). The components associated with the West Fisher road (215 habitat units) are similar to those being impacted by project activity in the upper Ramsey Creek area. The upper West Fisher road closure would also provide for a displacement area similar to the upper basin area being disturbed in Ramsey Creek. See discussion under Objective 1, 2 and 3 regarding the benefits of these road closures on space, displacement areas, seasonal components, and mortality risk.

Some concern has been expressed about the effectiveness of closing the West Fisher road, due to the presence of private land and unpatented mining claims behind the proposed closures. The West Fisher road accesses three patented properties. Reasonable access is legally guaranteed to private landowners. In the past several years, one landowner (Way-Up Mine properties) has shown interest in occassional access. Although having private property behind a closed gate can pose difficulties in managing the closure, this situation has been managed effectively in other drainages along the east Cabinet front (e.g. Cable Creek). The land acquisition program described in the next section could be targeted at purchasing private land located behind closed gates, and so could eliminate this potential conflict.

The upper West Fisher road accesses unpatented mining claims. Mining claimants are entitled to reasonable access to explore and operate their claims. This, however, does not mean that claimants are entitled to motorized access simply because they have claims. Motorized access on closed roads must be based on specific needs, which are evaluated on a case-by-case basis. There are virtually thousands of mining claims on the KNF located behind closed gates. Relatively few of these mining claims have presented a conflict with road management objectives. Although 21 claimants were identified as having mining claims accessed by the proposed West Fisher road closure, only two usually submit a Notice of Intent or Plan of Operations requiring access on an annual basis. (A complete listing of claimants and legal locations are available in the Montanore Project Files). Management of these access needs can be, and often are, accomplished in a manner that does not affect the objectives of the road closure.

The idea that grizzlies will use habitat associated with closed roads that receive a minor level of administrative use, seems to be partially supported by the fact that 6 captures of 3 grizzlies along the east Cabinet front all occurred less than 0.25 miles from a closed road.

Thus, even though a total restriction of motorized use would not likely be achieved on the upper West Fisher road, the controlled level of activity would still provide for an effective closure for grizzly bear habitat security if projections of future human activity are reasonably accurate. Traffic on this road would be monitored during project operations to determine the effectiveness of the road closure. As part of this mitigation plan, the information and education position would monitor road closure effectiveness and report this information to the Management Committee. If the Committee decides the road closure is not effective (road use exceeds acceptable standard), the KNF would substitute closure of the upper Bear Creek Road No. 4784, and reopen the West Fisher road for public motorized access.

The upper Bear Creek road is within Bear Management Unit No. 5, one of the two BMU's directly affected by project activities. It accesses an upper canyon with habitat similar to that being affected in Ramsey Creek, and thus meets the same objectives as that of the West Fisher road. About 138 habitat units would be gained by closure of this road. High value foraging components within the road influence zone include 161 acres of mixed shrubfield, 55 acres of riparian streambottom, and 27 acres of graminoid sidehill park.

If the upper Bear Creek closure is used as a replacement for the West Fisher, an additional 77 habitat units would need to be acquired through the land acquisition program.

The upper Bear Creek road was scheduled for closure in 1992 to bring Compartment No. 36 into compliance with Forest Plan road density standards (USFS, 1990: p.93). This plan has changed. The current plan is to close Road No. 6200, instead of the upper Bear Creek Road No. 4784, to achieve compliance with road density standards in Compartment No. 36. This change is the result of public comments received on the DEIS expressing concerns about closing the upper Bear Creek road yearlong. Based on this mitigation plan, the upper Bear Creek road would be closed each year on September 1, rather than on its current closing date of October 15 It would be closed yearlong as mitigation for the Montanore Project only if traffic on the upper West Fisher closure exceeds acceptable levels.

The three seasonal road closures previously discussed contain 660 habitat units within their influence zones, and would be used to mitigate for all habitat units (562) within influence zones affected by construction activities outside the upper Ramsey Creek basin. This immediate replacement in habitat units is desirable because it is unlikely that the land acquisition program would provide such short-term effects. The closures would also mitigate for 33 low elevation habitat units (4% of the project total) which occur within project influence zones during the operation phase. This includes 25 habitat units due to road realignment influence zones, and 8 habitat units due to the influence zone resulting from the tailings impoundment. Impacts occurring to habitat within influence zones on low elevation spring range areas (outside the upper canyons) can be adequately mitigated by spring road closures.

The remaining 537 habitat units needed for mitigation would be replaced by direct habitat acquisition, the purchase of conservation easements, or a combination of both. This includes habitat units which would be physically altered by project activities such as the tailings impoundment (41 h.u.), the percolation ponds (44 h.u.), plant site (49 h.u.), and the borrow pits (35 h.u.). Portions of these sites will have vegetation significantly altered, and complete reclamation of the tailings impoundment to pre-mine conditions is uncertain. The remaining 355 habitat units are those being influenced by project activities in upper Ramsey Creek, but would not be physically altered. Table 8 summarizes the methods of compensation employed for specific areas impacted.

Table 8. Methods of compensation for habitat impacted by the Montanore Project.

Habitat Units Impacted	Method of Compensation
Operation Phase	
(619) Upper Ramsey Creek basin	(215) West Fisher road closure (404) Land acquisition/easement
(133) Habitat units physically altered (33) Habitat units influenced on low elevation spring range sites.	(133) Land acquisition/easement (33) Spring road closures
Construction Phase	
(562) All habitat units influenced outside the upper Ramsey Creek basin on low elevation spring range sites.	(562) Spring road closures

Acquisition or easement would help prevent excellent bear habitat currently in private ownership from being developed. It could also increase habitat effectiveness if habitat can be enhanced through road closures or other direct improvement.

Purchase or easement could also decrease the chance of habitat fragmentation, which continues to be a major threat to the very narrow linear ecosystem surrounding the Cabinet Wilderness. Herrero (In press; pers. comm., 1992) describes the similar threat which exists in Canada to grizzlies occupying narrow, linear ecosystems such as Kootenai National Park. Harris (1984) also describes in detail the potential adverse consequences, such as local extinction, to small populations occupying fragmented ecosystems.

Several options are provided for the habitat acquisition program (see detailed mitigation plan in Appendix I). These options provide flexibility to ensure that the goal of providing grizzly bear habitat can be achieved. Under these options, Noranda could purchase properties and transfer fee title to the Forest Service or other agency, purchase and transfer title to a private conservation organization with an acceptable conservation easement attached, purchase and retain title with an acceptable conservation easement, or, in some cases, purchase an acceptable conservation easement with title retained by a third party. In any case, management of the acquired lands would be approved by the Management Committee.

Conservation easements would generally be established in perpetuity in order to avoid creating a "mortality sink", where bears accustomed to using the acquired lands become subject to development contrary to grizzly habitat objectives. McLellan (1988; pers.comm. 1992), during his nine year grizzly study in northwest Montana and southern British Columbia, considered controlling and reducing long-term access and human settlement in grizzly habitat after resource extraction has occurred, as the major positive factor on the rate of grizzly population increase.

In order to provide flexibility, the Management Committee could, on a case-by-case basis, accept conservation easements established for a fixed period of time extending throughout the life of the impacts (not in perpetuity). The Management Committee would need to consider the specific land involved and the impact that is being compensated for when determining the easement conditions for a specific parcel. For those parcels acquired to compensate for habitat influenced but not physically altered by project activities, conservation easements would remain in effect, at a minimum, until the activities in the upper Ramsey Creek basin have ceased, and the road system returns to its current yearlong closure status. For those parcels acquired to compensate for physically altered habitat, easements would remain in effect until, at a minimum, the disturbed areas have been adequately revegetated. For those sites where revegetation with grizzly bear foods is desired, adequate reclamation would be completed when grizzly bear foods attain 40% coverage on one-tenth acre vegetative plots randomly selected in the impacted area. This procedure is described in detail by Madel (1982), and was used as the basis for mapping high value foraging components in the Cabinet Mountains.

Noranda would provide the Forest Service "first-right-of-offer" before offering fee title of acquired lands to third parties. The Forest Service would seek a mineral withdrawal on any acquired lands to prevent future mineral entry. Under certain conditions, Noranda might also be able to enter into a land exchange with the Forest Service, and in return receive lands of equal value outside of grizzly bear habitat. The requirement of conservation easements in perpetuity, or in some cases an easement for the life of impacts, would eliminate or greatly reduce the potential for creating mortality sinks.

The total cost for habitat acquisition is estimated at approximately $4.2 million. This estimate is based on an average of approximately 3.9 habitat units per acre for the acquired lands, at an average cost of $2,000 per acre. The actual number of habitat units per acre, and the overall dollar per acre figure may differ from this estimate. Noranda would provide a performance (reclamation) bond at the time of permit issuance to ensure payment of these funds. This is the same mechanism used for operations on NFS lands, and used by the Department of State Lands, to ensure that required reclamation is completed for approved mineral projects.

Initially, a trust fund provided at the beginning of operations was considered as the mechanism to guarantee funding. The concept was for Noranda to pay into this trust fund the estimated amount needed for habitat acquisition. They would then be released from any further funding obligations. Noranda would neither be held responsible for insufficient funding of the program, nor would they be entitled to a refund of any excess funds. Insufficient funding would have resulted in failure to meet the objectives of the acquisition program.

The performance bond requirement included in the proposed action is also based on an estimate of acquisition costs, but does not release Noranda of the burden to fully fund the program, nor does it result in charging them excess costs. Should, for any reason, Noranda not comply with the requirements of this mitigation, the Forest Service could shut the operation down for failure to comply, take legal action to recover the performance bond, and then complete the acquisition program, or both.

If legal action is necessary to collect on the bond, then Noranda, if found in fault, would be responsible for all legal fees or court costs. The bond would be reviewed annually to determine if financial adjustments are necessary. The performance bond would insure sufficient up-front funding for acquisition of the lands necessary to mitigate for 537 habitat units (68%) affected by the project. If the upper Bear Creek Road #4784 is closed as an alternative to the upper West Fisher Road system, then 614 habitat units would need replacement through the land acquisition program. This would increase the acquisition costs to approximately $4.8 million. Appendix I provides a detailed explanation of how the exact bond estimate would be calculated.

Objective 5. <u>**Meet the management direction outlined in the Interagency Grizzly Bear Guidelines (51 Federal Register 42863) for management situations 1, 2, and 3.**</u>

The previously described Forest Plan standards and guidelines have been determined to meet the intent of the Interagency Grizzly Bear Guidelines (Buterbaugh 1991).

Statement of Findings

The proposed federal action "may adversely affect" the grizzly bear or its habitat. This determination is based on the following rationale.

The entire project area, with the exception of a portion of the powerline, has been delineated as Grizzly Bear Management Situation 1, where "grizzly habitat maintenence and improvement and grizzly/human conflict minimization will receive the highest management priority" (USFS, 1987).

After a five year study from 1983-1987, Kasworm and Manley (1988) concluded that the grizzly population in the Cabinet Mountains south of the Kootenai River may be 15 bears or fewer. Based on the capture of only 3 grizzlies despite an extensive trapping effort, the advanced age of the individuals captured, only one observation of a female with young, and the high mortality rates of marked bears, the continued existence of the Cabinet Mountains grizzly bear population is in serious doubt (Ibid.).

Sidorowicz and Gilbert (1981;cited in Madel 1983) have shown through modeling analysis for the Yukon that adult grizzly mortality above five percent of the adult population per year will cause a population decline. Studies conducted by Reynolds (pers.comm. 1992) throughout the interior of Alaska appear to support that finding. Age ratios from 24 grizzly populations throughout North America indicate that the average proportion of adults within a population is about 50% (USFWS, 1987). Assuming that 50 percent of the Cabinet grizzlies are adults, and an upper population estimate of 15 bears is realistic, then an average loss of more than 0.4 grizzlies per year (or about 1 bear every two years) will create a decline in an already seriously low population.

Due to the precarious status of this population, and high probability of the loss of this population in the next few decades (Kasworm & Manley, 1988), the proposed project may adversely affect the grizzly based on the following factors.

1) A long-term disturbance of at least 20 years will occur in the upper Ramsey Creek drainage, influencing over 7 square miles of space. This is important because the upper basin area is adjacent to the wilderness within the core of prime grizzly habitat. Excellent year-round habitat components are present with documented use by grizzlies. Bears could be displaced from important seasonal habitat components during critical use periods. Exclusion could limit access to important food sources and have an adverse effect if bears were required to seek foraging sites in less productive areas, or in areas closer to human disturbance. Displacement into or use of habitat less secure from humans can result in increased mortality for all age classes (USFWS, 1990). Females with cubs displaced into marginal habitat may experience physiological stresses related to decreased nutrient and energy intake, resulting in lower cub survivorship (Ibid.). If there was a real survival benefit associated with feeding in the upper Ramsey basin, some bears may continue to use the area but become more suseptible to human-caused mortality.

2) Over 1200 acres (USFS, 1991: pg.12) of bear habitat would be physically disturbed by project facilities, and would remain totally unavailable to bears during the project life, and perhaps for several years beyond. Almost all of this habitat is on low elevation spring range areas, which are very limited along the east Cabinet front during the critical period following den emergence. Considering the importance of high value food sources, particularly for female reproduction, the loss of habitat components could have an effect on bears which traditionally use the low elevation spring range sites in the proposed project area.

3) Adverse effects could also result from activity directly associated with mine development and operation. Grizzly mortalities could result from bears being illegally shot. Several illegal shootings of big game animals have already occurred in the project area by subcontractors for Noranda.

4) Adverse indirect effects could result from increased recreational activity in bear habitat, which raises the potential for increased human/grizzly conflicts.

5) Major activities will occur continuously along the east Cabinet front during the spring period (April 1 to June 15) throughout the life of the project.
Bears that may have traditionally used the impacted areas would need to adjust their normal behavior patterns. Due to the magnitude and duration of the disturbance, and the limited amount of spring foraging areas, this adjustment may have negative consequences for bear survival. Schoen and Beier (1990) monitored one female brown bear continuously in the core development area of the Greens Creek Mine in Alaska from 1982 through 1989. The bear successfully weaned 2 litters of 2 cubs each by 1986. After mill construction initiated in 1987, she lost two consecutive litters, and researchers suggest the possibility that displacement from her familiar feeding area along Zinc Creek in 1987 may have reduced her reproductive effectiveness.

The mitigation and compensation measures included in the proposed action would minimize the effects on grizzly bears and their habitat, and in some cases may actually have additional beneficial effects. The proposed action would result in immediate and long term benefits in gaining greater public acceptance of grizzly bear management in the ecosystem through the addition of an information and education specialist. Likewise, the addition of a law enforcement position would have immediate and long term benefits through reduction in grizzly bear mortality in the area. Arguably, the addition of both these positions would actually improve the existing situation for grizzly bears, beyond that needed to mitigate for direct and indirect effects of the project.

The land acquisition program should, in the long term, result in additional habitat available for grizzly bear use. Affected lands in the project area would be returned to grizzly bear use at the end of operations, in the case of lands not physically disturbed, or at the end of reclamation for lands physically disturbed. The intent of the plan is for most, if not all, of the acquired parcels to be managed for grizzly bear use in perpetuity. These lands might otherwise be developed in a manner inconsistent with bear needs. The end result should be a net gain in grizzly bear habitat over the long term. This additional habitat would be important in providing space for an increasing grizzly bear population.

Additional Potential Measures for Removing, Avoiding, or Compensating for Adverse Effects

1) Human-caused grizzly bear mortality is also a function of other complicated factors, such as the regulation of big game hunting, which is beyond the authority of the Forest Service to control. Kasworm (1988) emphasizes the impact of the general big game hunting season (particularly timing) on grizzly bear management. Two of the grizzlies radio-collared in the Cabinet Mtns. were illegally shot by hunters during the fall hunting season. Since 1975, in Montana and Idaho, there have been 11 instances of grizzly bear mortality related to mistaken identity involving black bear hunters (Ibid.). Regulation of hunting is the responsibility of the State of Montana. Measures which could be evaluated include removing the bear tag from the sportsman license, closing the fall black bear season on October 15, and closing the spring bear season along the east Cabinet front.

2) The Cabinet Mountains grizzly bear study conducted during 1983-1988 concluded that the future of the population was in serious doubt, and recommended population augmentation with subadult females having no history of conflicts with humans (Kasworm, 1991). The first of four projected transplants was completed in July of 1990, and was a 4 year-old female. Conclusions regarding the success of this bear as a transplant would be premature at this point, however the bear did remain within the Cabinet Mountains from the day of release until denning, and had little, if any, reported contact with people (Ibid). This pattern of use continued in 1991 before the bear dropped its collar in July.

If future proposed transplants prove to be successful, then this management technique may prove important in bolstering a population on the edge of extinction. Support of the augmentation program by Noranda, both financially or otherwise, could be an important factor in maintaining public support, and also in gaining public acceptance of additional transplants above and beyond those currrently scheduled.

3) During the three year construction phase, road densities in Compartment #37 could be reduced by 2.2 miles if Road #6210 was not reopened to haul waste rock from the Libby Adit site. This would lower open road densities in Compartment #37 to 0.80 miles per square mile, but would involve using a three mile segment of the main Libby Creek Road #231 as a haul route. Mixing public use and large haul trucks on this narrow road would result in serious safety problems. Significant reconstruction of this road with large cuts adjacent to Libby Creek would be required to allow for the safe use of this road (pers. comm., Paul Stantus).

BALD EAGLE

Description of Population and Habitat Status

Habitat for bald eagles in Northwest Montana consists of nest sites, winter roost sites, and feeding sites. Important year-round habitat includes major water bodies, fish spawning streams, ungulate winter ranges, and open water areas including wetlands.

Bald eagles occur throughout the year in the Kootenai River valley, but are most common during the month of November when fall migration is occurring. Numbers of migrating eagles have appearred to increase substantially along the Kootenai River since the late 1970's when systematic surveys were initiated. Typically, migrating eagles begin arriving in mid-October, with numbers peaking around mid-November. Numbers will occasionally peak again for a brief period in mid-February during spring migration. The greatest number of birds tallied in one day was 166, which occurred on Nov. 17, 1988, along the stretch of river from Libby Dam to Kootenai Falls (Libby District wildlife files). Table 9 displays the peak fall migration counts occurring on the Kootenai River since 1979.

Approximately 40-50 eagles winter along the Kootenai River and the lower stretch of Libby Creek during the months of December through February. Results of mid-winter eagle counts conducted the second week of January since 1980 are displayed in Table 10.

The lower eight miles of Libby Creek has been surveyed by Forest Service personnel since 1982. Peak counts have recorded up to 12 eagles (11/2/84) in this reach during the fall migration period (Oct.1 to Dec. 15). Bald eagles have also been seen as far upstream as the lower Libby Creek bridge (approx. 1.5 miles upstream from U.S.Hwy 2) during the fall whitefish spawning runs (personal observation). Adult birds have also been sighted along the lower eight mile stretch of Libby Creek during the nesting season, but these birds may be the same ones that are nesting along the Kootenai River.

Table 9. Peak fall migration bald eagle counts on the Kootenai River from Libby Dam to Kootenai Falls (Unpublished data, Libby District wildlife files).

Date	Total	Adults	Immatures	River Miles	Eagles/Mile
11/20/79	15	15	0	23	0.7
11/19/80	13	9	4	23	0.6
11/19/81	12	11	1	23	0.5
12/01/82	35	33	2	23	1.5
11/23/83	35	30	5	23	1.5
11/28/84	55	33	22	23	2.4
11/06/85	20	13	7	23	0.9
11/19/86	59	49	10	23	2.6
11/21/87	91	56	35	28	3.3
11/17/88	166	83	83	28	5.9
11/28/89	87**	(No adult/immature breakdown)		28	3.1
11/26/90	56	(No adult/immature breakdown)		28	2.0
11/20/91	42	(No adult/immature breakdown)		28	1.5

** After the survey route was completed on 11/28/89, the observer spent the next three hours at the base of Libby Dam, and counted an additional 110 bald eagles in flight migrating south along the Kootenai River corridor.

Table 10. Mid-winter bald eagle counts on the Kootenai River from Libby Dam to Kootenai Falls.

Date	Total	Adults	Immature	River Miles	Eagles/Mile
1/11/80	6	4	2	28	0.2
1/09/81	14	14	0	28	0.5
1/08/82	15	12	3	28	0.5
1/07/83	15	13	2	28	0.5
1/06/84	17	17	0	28	0.6
1/11/85	42	25	17	28	1.5
1/10/86	48	37	11	28	1.7
1/09/87	39	29	10	28	1.4
1/08/88	42	37	5	28	1.5
1/13/89	38	30	8	28	1.4
1/12/90	32	25	5	28	1.1
1/11/91	45	42	3	28	1.6
1/10/92	45	34	11	28	1.6

Nesting has also increased significantly in recent years along the Kootenai River and throughout the Kootenai Forest. No active nests were known to occur on the Forest in 1980, whereas 16 active nests were found in 1991. Three active nests along the Kootenai River from Libby Dam to Kootenai Falls have successfully fledged young each of the last 4 years. Nesting habitat is nearly always near open water and food. Nest habitat is a particularly important habitat factor because the breeding season is 5 months or more. Nests are usually in large live conifers or cottonwoods, and are used repeatedly.

Eagles predominantly use cottonwood and larch trees along the Kootenai River and Libby Creek as perch sites throughout the daylight feeding hours. These trees provide easy access to the waters surface where eagles prey on fish and waterfowl. Carrion, especially road-killed whitetail deer, is also used frequently by eagles. As mentioned, the closest documented perching/feeding area used by eagles is approximately 4 miles northeast of the proposed tailings impoundment along Libby Creek.

During the winter months, eagles will select night roosts which many times consist of mature, mid-slope,Douglas-fir stands adjacent to the riparian zone (personal observation). Two such areas have been documented along the Kootenai River.

No bald eagle nest sites, roost areas, or feeding/perching areas occur, or are likely to occur, anywhere in the project area, with the exception of a portion of the powerline cooridor along the Fisher River. Lack of eagle sightings in the project area is primarily due to the lack of large waterbodies. This inadequate hunting habitat also accounts for the lack of any bald eagle observations made during the baseline study (Thompson,1989).

As mentioned, bald eagles occassionally utilize portions of the transmission line corridor adjacent to the Fisher River as perching and feeding habitat, and as a flight corridor (Thompson,1989). Most use occurs during the fall and early spring migration, with less use during the winter.

Analysis of Effects, Including Cumulative Effects

The only direct loss of habitat which may occur is the removal of perch trees along the Fisher River from Sedlack Park to the mouth of Miller Creek. Due to the amount of suitable perching habitat available to the eagle in the surrounding area, the powerline construction should have no adverse affects on the biological or behavioral needs of the species.

Bald eagles use the lower 8 mile reach of Libby Creek seasonally, and the Kootenai River year-round. The degree to which the project could effect the eagle is related to the predicted effect on fish, its primary prey species.

No significant effects are anticipated to aquatic life in the project area or to fish (white sturgeon) in the Kootenai River (USFS, 1991: pg.117). The SDEIS (Chapter 4) acknowledges that concentrations of some potentially toxic metals are likely to increase in Libby Creek, which can increase stress to aquatic life. Conversely, the SDEIS also indicates that hardness and alkalinities in the stream are also likely to increase, which can help decrease stress to aquatic life. Also, the projected increases in many minerals (calcium, potassium,etc.) probably would increase the productivity of the aquatic community and growth rates for fish (Ibid: pg.115).

As mentioned previously, the majority of eagle use occurs approximately 15 miles north of the proposed project along the Kootenai River riparian zone. As discussed in the SDEIS (Chapter 4, Surface Water Hydrology), projected maximum discharges from the project would contribute less than 0.05 percent of the flow and less than 0.5 percent of the total manganese loading during low flow conditions in the Kootenai River. Such increases would likely be undetectable. Similar increases would be expected for other constituents in discharges from the project. In addition, since alkalinity and hardness of the Kootenai River is over 10 times greater than that found in Libby Creek, any metals entering the Kootenai River from the project would have very low bioavailabilities. Consequently, discharges from the project would not impact fish in the Kootenai River.

Neither laboratory nor field simulation studies can adequately mimic or model the ranges and combinations of water quality conditions that would occur in Libby Creek during the life of the mine; nor can such studies incorporate the range of possible adaptation, acclimation, and behavior modifications occurring within aquatic life (Ibid: pg.116). The only accurate way to evaluate impacts to aquatic life in the stream is to monitor for changes in instream aquatic life before, during, and after mine operations. Results from such continuing studies can then be used to guide any necessary changes in mine operations. The monitoring plan, designed specifically to address these issues, is presented in the SDEIS (Appendix B).

Statement of Findings

The proposed federal action is not likely to adversely affect the bald eagle or its habitat.

Potential Measures for Removing, Avoiding, or Compensating for Adverse Effects

The analysis performed in conjunction with this Biological Assessment identified no adverse effects on the bald eagle. The Aquatic Life Monitoring Plan detailed in Appendix B of the SDEIS is an integral part of the proposed action, and would be used to detect any adverse effects in the food chain utilized by bald eagles.

GRAY WOLF

Description of Population and Habitat Status

Availability of big game prey, and isolation from human disturbances and harassment are the key components of wolf habitat. Wolves are highly social animals requiring large areas (typically 40-1000 square miles per pack) to roam and forage). The denning period is critical because the pack must secure adequate prey to sustain themselves and approximately 4-7 pups. Pups are limited in their ability to hunt and sustain themselves for several months after birth. Wolves require a yearlong ungulate prey base with adequate alternate species, typically small mammals.

The project area is outside the Northern Rocky Mountain Wolf Recovery Area, and there have been no sightings or recordings of wolves in the project area. No evidence was identified to suggest the species presence in this general area (Thompson, 1989; Farmer and Heath, 1987).

Analysis of Effects, Including Cumulative Effects

As of September 1, 1992, all compartments within Bear Units 5 & 6 will be in compliance with Forest Plan road density standards. This should have a benefical effect on big game, the primary prey species of wolves. The proposal would reduce the effective habitat as discussed under the grizzly bear analysis. Increased human activity and access that would occur on previously available effective habitat would not have a significant effect on wolves, since the potential for wolves to be found in the area is very remote.

Deliberate or accidental human-caused mortalities would be minimized by implementing the grizzly bear mitigation plan, and incorporating all other wildlife measures specified in the permit.

Statement of Findings

The proposed federal action will have no effect on the gray wolf or its habitat.

Potential Measures for Removing, Avoiding, or Compensating for Adverse Effects

The analysis performed in conjunction with this Biological Assessment identified no adverse effects on the gray wolf. No mitigation or compensation for adverse effects is required.

PEREGRINE FALCON

Description of Population and Habitat Status

The primary habitat feature for peregrine falcon habitat is suitable cliffs or rock ledges for nesting. Suitable cliffs often dominate the surrounding area and may have a sweeping view of the valley. Nest sites usually are located near areas where passerine birds or waterfowl are available for food. Skaar (1985; cited in Thompson 1989) indicated that there is only circumstantial evidence of peregrines breeding in the Libby latilong block and notes that most breeding records for the state are old. There are no current or historical nesting sites (eyries) known to occur in the project area.

Portions of the Montanore Project study area support apparently suitable prey populations in settings which would make them vulnerable to peregrine attack, and there are several cliffs that were tentatively identified during the baseline study as potential nesting sites (Thompson,1989). Two of the more suitable potential nesting sites are the cliffs east of Rock Lake, and the cliff on the west side of Goat Creek in the upper Libby Creek basin (Ibid.). Both sites are sheer cliffs of suitable height, aspect, and ledges that are in or close to habitats supporting moderate to high densities of preferred prey species. The problem with both sites, however, is that the cliffs accumulate heavy snows which in 1989, a "normal" winter, did not begin sliding off the cliffs until mid to late April. By the time these cliffs were sufficiently snowfree, the delayed nesting phenology could make these sites unsuitable (Ibid.). No peregrines were observed during the ASARCO Rock Creek baseline studies (Farmer and Heath,1987), or during the Montanore Project baseline studies (Thompson, 1989).

The peregrine falcon has been identified by the U.S. Fish and Wildlife Service as a migrant. Peregrine falcons are believed to migrate through the project area during their spring and fall migrations. Although no sightings have been reported, this may be due to the number of few qualified observers, lack of systematic surveys during migration periods, and/or low numbers of migrants. Peregrine use is probably limited to occasional perching, overnight roosting, or pursuing prey during migration movements. Snags are abundant throughout the project area.

Analysis of Effects, Including Cumulative Effects

The proposed action would displace peregrine falcons that were roosting or perching within the immediate area. This effect would not be significant due to the availability of similar undisturbed habitat in the surrounding area.

Statement of Findings

The proposed federal action will have no effect on the peregrine falcon or its habitat. Potential nesting habitat is very limited in the upper Ramsey basin area, and perching/roosting habitat is freely available in the surrounding area.

Potential Measures for Removing, Avoiding, or Compensating for Adverse Effects

The analysis performed in conjunction with this Biological Assessment identified no adverse effects on the peregrine falcon. No mitigation or compensation for adverse effects is required.

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APPENDICES

Appendix i. Grizzly Bear Mitigation Plan.

Appendix ii. Record of Informal Consultation with U.S.Fish and Wildlife Service:

See attached record of correspondence.

Appendix iii. TES Conservation Measures Implemented to Date on the Kootenai National Forest

A list of all conservation measures implemented to date and ongoing is on file at the Kootenai National Forest Supervisors Office, Libby, MT. 59923

Detailed maps of the proposal along with disturbance overlays have been sent to the Fish and Wildlife Service (Kalispell Office) for their review.

APPENDIX I - DETAILED MITIGATION PLAN

As an integral part of the proposed action, the Forest Service has developed a mitigation plan intended to reduce or minimize the effects on grizzly bears and their habitat. Specifically, the mitigation plan is intended to reduce direct, indirect, and cumulative effects by providing for the spatial requirements of the bear, managing for an adequate distribution of bears, reducing mortality risks, and maintaining habitat suitability with respect to bear food production. The mitigation plan is divided into five main parts. The effects of implementing this plan are discussed under the section entitled GRIZZLY BEAR, Analysis of Effects.

MITIGATION PLAN MANAGEMENT

A Management Committee would be established to oversee implementation of the mitigation plan. The committee would consist of personnel from the U.S. Fish and Wildlife Service, the Montana Dept. of Fish, Wildlife, and Parks, and the Kootenai National Forest. Noranda would be respresented on the committee but would not be a directing member.

The duties of the Management Committee would be as follows:

- Priortize and direct the land acquisition program.

- Evaluate proposals and approve specific habitat enhancement projects for acquired lands.

- Review progress reports on the status of the mitigation program.

- Determine effectiveness of the West Fisher road closures.

- Direct the activities of the Information and Education program.

- Evaluate the need for the I&E position after five years, and determine if the funds should be directed towards monitoring, research, or habitat management. Direct these activities if they occur.

- Evaluate the effectiveness of reclamation and determine when roads closed as part of mitigation can be reopened, and the specific timing for releasing acquired lands.

The land acquisition functions of the Committee generally would be conducted as follows:

- The Committee would develop a list of desirable lands to acquire, and would priortize these lands in order of importance taking into account the number of habitat units per acre available for each parcel, the location relative to the project area, and other related factors.

- Noranda would be responsible for carrying out the acquisition program, either directly or through contract with a third party.

- The Committee would be responsible for review and approval of each acquisition prior to purchase, and approval of conservation easements.

LAW ENFORCEMENT AND INFORMATION/EDUCATION PROGRAMS

Two new full-time wildlife positions would be created, with duties aimed directly at minimizing effects on grizzly bears. This includes a law enforcement officer and an information and education specialist.

Funding for the two full-time positions would be as follows:

- Noranda would fund each of the positions on an annual basis. The estimated mated total cost for the positions is approximately $2.9 million over the life of the project, assuming an initial annual cost of $96,000. per year and an average inflation rate of 4.2% per year (approximately $1.9 million in today's dollars).

- Noranda would be informed two months prior to the beginning of each fiscal year the amount of monies needed to fund the positions for the following year, and a bill for collection issued.

- Monies for the positions would be placed in a cooperative or similar account one month prior to the beginning of each fiscal year. The Management Committee can make other arrangements as appropriate.

The law enforcement position:

- Would be an employee of the Montana Department of Fish, Wildlife, and Parks.

- Would be funded through the end of the operating period.

- Would be assigned to a specific area generally encompassing the southern portion of the Cabinet Mountains, particularly the East Front. A position description is included as Exhibit A.

The Information and Education position:

- Would be an employee of either the U.S. Fish and Wildlife Service, Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, or Noranda, as determined by the Management Committee.

- Would include presenting grizzly bear conservation programs to mine employees, civic groups, and schools; make field contacts with recreationists and other Forest users who recreate in bear habitat; conduct compliance checks dealing with permit stipulations and road management; cooperate with Federal and State Agencies and/or private landowners involved with grizzly management; prepare progress reports on the status of the mitigation program; and conduct reconnaissance of acquired lands and provide recommendations for habitat management. A position description is provided in Exhibit B.

As discussed, the Management Committee would decide if the Information and Education position should be continued after the first five years of the project, or whether the funds should be used instead for programs such as grizzly bear monitoring, research, or habitat management. If the position is terminated at year 10, approximately $500,000 (today's dollars) would be available over the remaining life of the project for the above mentioned purposes.

In the future, if additional mines are developed in the Cabinet Ecosystem, funding for both positions may be shared by other mining companies, subject to approval by the Management Committee.

HABITAT PROTECTION

There are three sub-parts to this mitigation measure; habitat acquisition, road management, and management of patented mill site claims.

Road Management

Road management mitigations include both yearlong and seasonal closures. These closures are intended to off-set immediate effects of the mine operation by providing additional security adjacent to the impacted area, and replacing lost space and habitat units. The Forest Service would close six road segments in addition to those required to meet Forest Plan standards, along with extending the closure on the upper Bear Creek Road #4784 from Sept. 1 to June 30 (current motorized closure on this road is from Oct. 15 to June 30)

The upper 6.4 miles of the West Fisher Road system would be closed yearlong by closure of three road segments (No. 6746, No. 6744, and No. 6746 C) (Figure 5). These road closures would be in effect prior to beginning construction activities, and continue through the operating period and into the reclamation period. The Management Committee would evaluate the effectiveness of these road closures and, if determined to be ineffective, replace them with a yearlong closure of the Bear Creek Road #4784.

Three road segments would be closed on a seasonal basis (April 1 to June 30). These include the South Fork Miller Road (No. 4724), the Midas Creek Road (No. 4778), and the Deep Creek Road (No. 4791) (Figure 5). These road closures would remain in effect throughout the project life and into the reclamation period. These closures would be as follows:

- The South Fork Miller Creek Road No. 4724 (6.6 miles) would be closed at the junction of the main Miller Creek Road No. 385.

- The Midas Creek Road No. 4778 (6.6 miles) would be closed at the junction of the main Libby Creek Road No. 231 on both the north end and the south end east of Howard Lake. This southern segment of the No. 4778 Road requires closing since it is a "tie-through" road accessing the Miller Creek Road No. 4724.

- The Deep Creek Road No. 4791 (5.2 miles) would be closed at the junction with Road No. 4792.

Habitat Acquisition

Noranda would purchase private lands or purchase conservation easements on private lands. The purpose of this mitigation is to replace space and bear habitat affected by the operation by protecting private lands that otherwise could be developed for other purposes. Approximately 537 habitat units would be purchased under this acquisition program. This is the amount of habitat units affected by the operation that are not replaced through road closures. Acquisitions would be completed within a six year period, beginning at the time of construction, with at least 50 percent completed within the first three years. Acquired lands would be managed for the best interest of the grizzly bears throughout the life of the impacts. All management would be approved by the Management Committee. Selection and approval of parcels to be acquired would be directed by the Management Committee.

The location of acquired lands would be within the Cabinet portion of the Cabinet-Yaak Ecosystem. Preference should be given by the Management Committee for lands within the affected Bear Management Units and lands along the east side of the Cabinet Mountains. Because of the potentially limited amount of lands that may be available for acquisition within this area, and for biological reasons, lands within other portions of the Cabinet Mountains might also be considered.

The acquisition plan provides flexibility to allow the Management Committee with options for meeting the objectives. Per agreement between the Management Committee and Noranda, any of the following could occur with the acquired parcels:

- Noranda could purchase the private parcels directly, and then transfer title to the KNF, or other state or federal resource management agencies.

- Noranda could purchase the private parcels directly, and then transfer title to a private conservation organization, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.

- Noranda could purchase private lands directly, and then retain title to the lands, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.

- Or, in some instances, Noranda could purchase a conservation easement with fee title remaining with the private party.

Conservation easements generally would be established in perpetuity. The Management Committee could, on a case-by-case basis, accept conservation easements established for a fixed period of time extending throughout the life of the impacts (not in perpetuity). If this option is selected:

- For those parcels acquired to compensate for habitat influenced but not physically altered by project activities, conservation easements would remain in effect, at a minimum, until the activities in the upper Ramsey Creek basin have ceased, and the road system returns to its current yearlong closure status.

- For those parcels acquired to compensate for physically altered habitat, easements would remain in effect until, at a minimum, the disturbed areas have been adequately revegetated. For those sites where revegetation with grizzly bear foods is desired, adequate reclamation would be completed when grizzly bear foods attain 40% coverage on one-tenth acre vegetative plots randomly selected in the impacted area. This procedure is described in detail by Madel (1982), and was used as the basis for mapping high value foraging components in the Cabinet Mountains.

Noranda would provide the Forest Service "first-right-of-offer" before offering fee title of acquired lands to third parties. The Forest Service would seek a mineral withdrawal on any acquired lands to prevent future mineral entry. Under certain conditions, Noranda might also be able to enter into a land exchange with the Forest Service, and in return receive lands outside of grizzly bear habitat.

After the Management Comiittee determines that project impacts have ended, the acquired lands could be used by others seeking mitigation for effects on grizzly bears, providing that acceptable conservation easements or other conditions are satisfied to protect these lands for grizzly bear use.

The direct cost for habitat acquisition is estimated at approximately $4.2 million. This is based on an estimated average of 3.9 acres per habitat unit at an estimated cost of $2,000 per acre. The actual cost for these lands would vary based on factors such as parcel size, location, owner, time of purchase, and whether or not a conservation easement was included with the property.

The bond estimate is made as follows:

An average habitat unit being impacted by the Montanore Project represents 3.9 acres. This figure was derived simply by dividing the total number of acres in the project influence zones (5146 acres) by the total acreage of habitat units within this zone (1317 h.u.). This factor of 3.9 is then used to convert habitat units to acres. The 537 habitat units multiplied by 3.9 would equate to 2094 acres. This acreage figure would be considered as the amount of land needed to compensate for the habitat effected by the project.

The total acreage figure is then multiplied by an average dollar per acre value for desirable private lands in bear habitat along the east Cabinet front. Determination of the average dollar per acre value for land along the east front was taken from information provided by the KNF Lands Staff (T.Anderson,pers.comm.,1/10/92), and was estimated at $2000./acre. This estimate could vary, of course, depending on factors such as parcel size, location, and owner. At the time of permit issuance, an updated estimate will be made of the going market rate for targeted lands based on the highest and best use. The total acreage figure of 2094 multiplied by $2000. provides a total dollar estimate of $4,188,000. This figure is the estimate of the bond value needed for land acquisition to replace the remaining habitat units affected by the project.

Noranda would guarantee funding for the acquisition program through payment of a performance or reclamation bond. This would be handled as follows:

- The performance bond would either be separate from or included as part of the standard reclamation bond posted for the project. The bond would be posted prior to construction activities.

- The bond would be based on the cost of acquisition estimated at the time of project start-up. The estimate would be based on a survey of the current average price per acre for lands within the acquisition area.

- The bond would take into account any lands that Noranda might have already purchased prior to that time, providing that the Management Committee accepts such lands for mitigation. This provides Noranda with the flexibility of obtaining lands now, but does not commit the Management Committee to accepting them as part of the mitigation package.

- If, because of failure on Noranda's part, it becomes necessary to collect the bond, Noranda would be responsible for all legal fees incurred by the Forest Service. Since completion of the acquisition program would be a provision of project approval, failure to comply could result in project shutdown.

- The bond would be reviewed annaully to determine if the bond amount should be adjusted.

MANAGEMENT OF PATENTED LANDS

Any mill site claims that Noranda might patent as a result of the Montanore Project, or mining claims that may be patented on the mineral deposit, would be managed to provide for grizzly bear use subsequent to the mining operation. This is to ensure that these lands are not developed after the mining operations for uses that could be detrimental to grizzly bears. Patented claims would be handled in one of three ways:

- As agreed to between Noranda and the Forest Service, Noranda would transfer fee title to the Forest Service once reclamation of the lands has been completed.

- Noranda would retain title to the lands, but would provide a permanent conservation easement directed at protecting the land for use by grizzly bears. The Management Committee must approve the provisions of the easement.

- Noranda could sell the lands to another party providing that a permanent conservation easement is included. The Management Committee must approve the provisions of the easement.

ADDITIONAL MEASURES

Additional measures would be implemented to reduce mortality risk directly associated with the project.

- The Forest Service would restrict public motorized travel in the upper Ramsey Creek drainage. This restriction will occur at the northeast corner of Sec.2 (T27N,R31W), at the junction of Road #6210.

- The Forest Service would set speed limits along access roads to minimize the amount of road kill that could in turn attract bears.

-Noranda would remove road kill from roads on a daily basis to reduce the potential for human-bear interaction.

- Noranda would prohibit employees from carrying firearms within the permit area, except for security officers and other designated personnel.

- Noranda would use bear proof conatiners for garbage, and would prohibit employees from leaving foods or other bear attractants in the field.

- Noranda would prohibit employees from feeding bears..

EXHIBIT A

GAME WARDEN JOB DESCRIPTION

AREA OF RESPONSIBILITY

The area of responsibility will be the south Cabinet Mountains in and around the Montanore Project site. Specific jurisdictional boundaries will be set by the Montana Dept. of Fish, Wildlife, and Parks with approval from the Management Committee. The suggested general boundaries would be Highway 2 on the north and east, Highway 56 and 200 on the west, and the Vermilion River on the south.

DUTIES

-- To patrol lands and waters of the state of Montana.

-- Enforce state wildlife conservation laws and Fish and Game Commission regulations, with regard to licenses, bag limits, species, litter, vandalism, boat safety, snowmobile licensing and safety, and park and recreation area regulations.

-- Enforce Forest Service regulations regarding road closures.

-- Contact hunters, fisherman, and other recreationist in the field, including outfitter camps.

-- Conduct investigations and collect evidence.

-- Promote good relations between landowners and sportsmen.

-- Trap and transplant problem animals.

-- Conduct classes in hunter safety.

-- Audit and administer license agent accounts.

-- Assist in the collection of wildlife management research and environmental protection information. Duties may include assisting the Information and Education Specialist/Biologist in the collection of monitoring or research data related to the Montanore Project.

-- Coordinate and network with the Management Committee as needed.

EXHIBIT B

INFORMATION & EDUCATION SPECIALIST JOB DESCRIPTION

For purposes of this job description, the terms "agency" or "agencies" will refer to the three principle agencies comprising the Bear Management Committee: namely, the United States Forest Service, the United States Fish & Wildlife Service, and the Montana Department of Fish, Wildlife, and Parks.

AREA OF RESPONSIBILITY

This position will focus around the community of Libby, with field work directed to the area in and around the project site, and also along the entire east Cabinet front. As time allows, the duties described below can also be directed to the Noxon/Trout Creek communities, and also along the west Cabinet front and Bull River valley. The Management Committee will provide direction as progress is monitored.

DUTIES

-- Present grizzly bear conservation programs to mine employees, civic groups, and schools. Identifies items to be addressed, characteristics and needs of the target audience, and communication techniques most appropriate. Develops recommended approaches, and drafts material for Bear Mgmt. Committee approval.

-- Responds in a timely manner to requests for information from interested publics, including other agencies and organizations. Acts as liaison to local legislative officials, and responds to requests for information.

-- Organizes and conducts field trips, workshops, public meetings, and/or other forums designed to foster public understanding and participation in bear management.

-- Gathers information from a variety of sources including interviews, study, research, and observation. Develops written materials, such as feature stories, news releases, and magazine articles, that transmit information concerning the nature and purpose of the agencies bear management programs. Develops and maintains an effective working relationship with media representatives in the surrounding local communities.

-- Makes recommendations to the Bear Management Committee on new methods or procedures that will better involve the public and help interested persons recognize that their comments concerning bear management are being used in the agencies decision making process.

-- Make field contacts with recreationists and other Forest users who recreate in bear habitat.

-- Conduct compliance checks dealing with permit stipulations (i.e. firearms, garbage, speed limits, and public access into upper Ramsey Creek).

-- Patrol closed roads and issue violation citations as warranted.

-- Contact hunters (especially during the spring bear season), and provide information on black and grizzly bear identification techniques.

-- Provide appropriate signing at trailheads and campgrounds to inform the public on proper conduct in grizzly bear habitat (performed in conjunction with standard F.S. procedures).

-- Conduct reconnaissance of acquired lands and provide recommendations for habitat management.

-- Prepare progress reports on the status of the mitigation program.

-- Cooperate with Federal and State Agencies and/or private landowners involved with grizzly management.

SUPERVISORY CONTROLS

-- The employee can work for either the U.S. Fish & Wildlife Service, the Forest Service, the Montana Dept. of Fish, Wildlife, and Parks, or Noranda as determined by the Management Committee. The Management Committee will also have final approval of any individual hired. The Committee will initially define objectives, priorities, and deadlines, and assist the specialist with unusual situations which do not have clear precedents. The Committee will provide timely advise and review potentially controversial issues.

-- Most assignments are carried out independently in accordance with Management Committee objectives and guidelines. The specialist develops, plans, and carries out the various stages of projects, selecting and using methods and techniques as appropriate.

-- Problems encountered with news media, agency officials, publics, and/or requests for questionable information are discussed with the Bear Management Committee.

-- Completed work is reviewed for achievement of program objectives. Liaison activities are evaluated for effectiveness and initiative in promoting program objectives and cooperation with target audiences.

APPENDIX II

RECORD OF INFORMAL CONSULTATION WITH USFWS

6/8/88 Field review with L. Lockard (UFWS) and A. Bratkovich (KNF). Field reviewed Borax's (now Noranda's) proposed mine facilities.

11/2/89 Meeting with USFWS, MDFWP, IMS, and KNF. Attending were L. Lockard (USFWS), J. Brown (MDFWP), P. Davis (IMS, KNF contractor), and R. Erickson, B. Summerfield, B. Haflich, A. Bratkovich, and L. Fairman (KNF). Primary objective was to initiate informal consultation process. Discussed cumulative effects computer model and methods of analysis, possible mitigation measures, and possible funding mechanisms.

5/14/90 Meeting with USFWS, IMS, and KNF. Attending were L. Lockard (USFWS), P. Davis (IMS), and J. Mershon, B. Haflich, A. Bratkovich, and R. Erickson (KNF). Purpose of meeting was to discuss the biological assessments (BA's) being prepared for the ASARCO Rock Creek and Noranda Montanore Projects. Discussed content of draft BA's, information/education and game warden positions, procedures for formal consultation on both projects at the same time, trust fund concept, need for specificity in describing mitigation measures, possible patenting of mill site claims, and dropping certain compensation measures from consideration.

5/14/90 Meeting with USFWS, Noranda, IMS, and KNF. Attending were L. Lockard (USFWS), J. Scheuering, D. Myers, M. Petersmeyer, and B. Bailey (Noranda), P. Davis (IMS), and R. Erickson and A. Bratkovich (KNF). Purpose of meeting was to discuss draft BA prepared for Montanore Project. Discussed habitat in CYE, timing of acquisition program, and financial guarantee for compensation plan.

7/2/90 Meeting with USFWS, MDFWP, Noranda, and the USFS. Attending were L. Lockard, D. Harms, and C. Servheen (USFWS), H. Nyberg and J. Mundinger (MDFW&P), J. Scheuering, M. Petersmeyer, T. Babcock, D. Parker, and J. Elliott (Noranda), and R. Erickson, B. Ruediger, D. Pederson, A. Bratkovich, R. TeSoro, K. Horn, B. Schrenk, and B. Haflich (USFS). Purpose of meeting was to discuss differences in Noranda's and the Agencies' proposed grizzly bear mitigation packages.

7/19/90	Meeting with USFWS, MDFWP, Noranda, and KNF. Attending were L. Lockard (USFWS), H. Nyberg (MDFWP), J. Scheuering, J. Elliott, D. Parker, and M. Petersmeyer (Noranda), and R. Erickson, C. Howard, B. Haflich, J. Mershon, B. Summerfield, and A. Bratkovich (KNF). Purpose of meeting was to discuss BA's being prepared for ASARCO Rock Creek and Noranda's Montanore projects, and to discuss Noranda's proposed compensation plan. Discussed cumulative effects model and possible compensation measures.
8/14/90	Meeting with USFWS, MDFWP, Noranda, IMS, and KNF. Attending were L. Lockard (USFWS), H. Nyberg (MDFWP), J. Scheuering and D. Parker (Noranda), P. Davis (IMS), and D. Pederson, A. Bratkovich, B. Summerfield, B. Haflich, and R. Erickson (KNF). Purpose of meeting was to discuss Noranda's grizzly bear mitigation proposal. Discussed analysis of effects, habitat loss replacement, roles and responsibilities in accomplishing compensation plan, and financial strategies for guaranteeing compensation. Decided both mitigation proposals would be presented in DEIS, and formal consultation would occur at FEIS stage.
3/19/91	Meeting with USFWS, MDFWP, Noranda, and the KNF. Attending were L. Lockard (USFWS), H. Nyberg (MDFWP), D. Parker, J. Elliott, and M. Petersmeyer (Noranda), and B. Thompson, B. Summerfield, D. Cohan, D. Pederson, and A. Bratkovich (KNF). Purpose of the meeting was to discuss the cumulative effects model and analysis, and to review Noranda's proposed mitigation plan. Discussed cumulative effects model computer program errors, compensation for project versus recovery program, possible compensation measures, financial guarantee methods, and timing of BA submittal to USFWS.
3/20/91	Letter to K. McMaster, USFWS, from B. Schrenk, KNF. Informs USFWS of problem with computer software used to run cumulative effects model. Requests concurrence for use of hand computations using the model.
4/5/91	Letter to B. Schrenk, KNF, from K. McMaster, USFWS. Concurs with KNF proposal to use hand computations.
8/29/91	Meeting between L. Lockard (USFWS), and A. Bratkovich and B. Summerfield (KNF). Purpose of meeting was to discuss grizzly bear mitigation plan. Discussed both seasonal and yearlong road closures, mitigation package presented in DEIS, and potential properties that could be acquired to offset impacts.

9/20/91 Letter from D. Harms, USFWS, to R. Schrenk, KNF. Letter is in response to August 16, 1991 Federal Register notice that indicated that FS was considering changes in proposed grizzly bear mitigation plan. Letter encourages FS to propose a compensation package that remains consistent with past informal consultation understandings.

10/17/91 Letter from R. Schrenk, KNF, to D. Harms, USFWS. Leter is in response to 9/20/91 USFWS letter. Letter agrees with concern to implement adequate compensation package.

12/20/91 Meeting with USFWS, MDFWP, and KNF. Attending were D. Harms and L. Lockard (USFWS), H. Nyberg (MDFWP), and D. Pederson, B. Summerfield, A. Bratkovich, and B. Thompson (KNF). Discussed preferred alternative in SDEIS, specifics of compensation plan, establishment of Management Committee, and submittal of BA and formal consultation.

APPENDIX D—VISUAL SIMULATIONS

THE following photographs are visual simulations of three project facilities—the plant site, the tailings impoundment, and the transmission line.

FIGURE D-1
VISUAL SIMULATION OF PROPOSED PLANT SITE FROM ELEPHANT PEAK

FIGURE D-2.

VISUAL SIMULATION OF PROPOSED TAILINGS IMPOUNDMENT FROM LIBBY CREEK ROAD

VISUAL SIMULATION OF PROPOSED TRANSMISSION LINE FROM HOWARD LAKE CAMPGROUND

APPENDIX E—MANAGEMENT AREA DESCRIPTIONS

AS discussed in Chapters 2 and 4, development of the Montanore Project would require amending the KNF Forest Plan. Areas presently classified as corridor avoidance areas that would be crossed by the transmission line would be amended to Management Area 23—Electric Transmission Corridor. The tailings impoundment area would be amended to Management Area 31—Mineral Development. MA 31 would be a new MA on the KNF. The goals and standards for these two MA are described in the following sections. Chapters and appendices refer to those in the Forest Plan (Kootenai National Forest, 1987).

MANAGEMENT AREA 23

Electric Transmisison Corridor

A. DESCRIPTION

This MA is composed entirely of the existing electric transmission corridor on the south end of the Forest which crosses along the south boundary of the Cabinet Mountains Wilderness. There is a low-standard access road providing repair and inspection access for the entire length. Vegetation varies from shrubs to small conifers. Almost all acres are in grizzly bear situation 1 and 2.

B. GOALS

Provide for the transmission of electricity in a safe and efficient manner. Protect the adjacent wilderness character, contribute to the diversity of surrounding wildlife habitat, and provide as much security as possible for the grizzly bear.

C. STANDARDS

1. These standards will also apply to any future corridors which may be located and approved.
2. The Forest-wide a mangement direction included in Chapter II of this plan applies to this MA.

Recreation

1. The VQO is maximum modification.
2. The ROS class is predominantly rural.
3. Over-snow vehicles are allowed when conflicts with big game can be avoided.

Wildlife and Fish

1. Vegetation control will be coordinated with wildlife use to provide forage for winter range at lower elevations.
2. Security for wildlife will be provided by regulating access along the corridor. Regulation may include seasonal closures to all motorized vehicles but powerline maintenance personnel.
3. Any activity in this MA will be required to leave no trash or other grizzly attractant. Standards and guidelines specified in Appendix 8 (Grizzly Management Situation Guidelines) will be applied for all activities on grizzly habitat.
4. Controls will be determined site specifically, but any herbicide used may not enter any water course.

Range

Grazing domestic livestock is permitted on the portions where grazing is also permitted on the adjacent MA.

Timber

1. This MA is not suitable for timber production.
2. Culture and harvest of Christmas trees or other products which can safely be grown and harvested under the powerline is permitted.
3. Harvest units in adjacent MAs should be planned to add visual diversity to the corridor edges.

Soil, Water and Air

1. Soil and Water Conservation Practices will guide the implementation and mitigation of all land disturbing activities.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana State Airshed Group.

3. Public motorized access may be restricted because of the need to control erosion on steep grades.

Mineral and Geology

1. Refer to Forest Standards for locatable minerals. Seasonal restrictions may occur.
2. Seasonal restrictions may be required for oil and gas leases and geophysical activities.
3. Generally, disposal of common minerals will not be permitted.

Facilities

1. The powerline access roads will be open to maintenance crews at all times.
2. Public access may be restricted based on the access restrictions of adjacent MAs.
3. Open roads will be maintained at level 2 or better.
4. Because of some steep grades on access roads, erosion control measures including structures, drainage dips, etc. will be inspected annually and constructed or maintained to prevent soil loss.

Fire

Prescribed Fire

Planned Ignitions—Planned ignitions for disposal of activity fuels or wildlife habitat enhancement are permitted.

Unplanned Ignitions—Unplanned ignitions as prescribed fire are not permitted.

Wildfire

All seasons—All wildfires will be controlled.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade

None planned

Projected - Second Decade

None projected.

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation	A-3, A-5, A-7
Range	D-1, D-2
Human & Comm Dev.	H-3, H-4
Facilities	L-1, L-2

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

MANAGEMENT AREA 31

Mineral Development

A. DESCRIPTION

This MA consists of permitted land areas that are directly involved with mineral production facilities such as major mine portals, mineral ore processing facilities, mineral tailings impoundments, water diversion structures, percolation areas, pipelines, and long-term equipment occupancy areas. They can be located within or adjacent to other MAs, depending on the final approved location of the mine and the necessary supporting facilities.

B. GOALS

Provide for safe and healthful working areas for mineral production workers that are in concert with the surrounding MAs as much as possible. Additional sites for this MA will be provided as demand and successful mineral discoveries permit. The VQO is maximum modification.

C. STANDARDS

1. These standards will apply to all mineral development areas.
2. The Forest-wide management direction included in Chapter II of this plan applies to this MA.

Recreation

1. There is no ROS class associated with this MA.
2. ORV use is not permitted in this MA.

Wildlife and Fish

1. Locate facilities, if possible, away from important winter range, calving areas, riparian areas and meadows.
2. Activities will be scheduled, if possible, to prevent conflict with wildlife use in adjacent MAs, particularly winter range use.
3. Activities will be conducted to prevent siltation in streams that provide spawning habitat for both resident and migratory fish.

Range

Domestic livestock grazing is generally not permitted.

Timber

1. This MA is not suitable for timber production.
2. Salvage harvest may occur to remove trees infested by insects or disease, to remove hazard trees, or for other land clearing necessary for mineral production purposes.
3. Landing areas for timber harvest on adjacent MAs are permitted if there is no conflict with the mineral production facility, soil protection, water quality, or cultural site protection.

Soil, Water and Air

1. Soil and Water Conservation Practices will be followed for any activity.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana Airshed Group.
3. Special considerations will be made for protection of reclaimed slopes and soils in all activities within this MA.

Riparian (See Riparian Area, Chapter III)

Minerals and Geology

1. Refer to Forest standards for locatable minerals. Seasonal restrictions may occur.
2. Stipulate no surface occupancy for oil and gas leases.
3. Removal of common minerals will generally not be permitted unless it is consistent with the mineral production facility needs.

Lands

Special uses, rights-of-way, easements, or cost-share agreements may be authorized on a case-by-case basis, provided that they are consistent with the mineral production facility.

Facilities

1. Permanent roads are anticipated and will be maintained for safe use.
2. Temporary roads will be closed, drained, and revegetated.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade

None planned

Projected - Second Decade

None projected

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation	A-7
Wildlife and Fish	C-9
Soil and Water	F-1
Minerals	G-1

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

APPENDIX F— PROPOSED ENVIRONMENTAL SPECIFICATIONS FOR THE 230-kV TRANSMISSION LINE

DEFINITIONS

ACCESS EASEMENT:	Any land area over which the OWNER has received an easement from a LANDOWNER allowing travel to and from the project. Access easements may or may not include access roads.
ACCESS ROAD:	Any travel course which is constructed by substantial recontouring of land and which is intended to permit passage by most four-wheeled vehicles.
BEGINNING OF CONSTRUCTION:	Any project-related earthmoving or removal of vegetation (except for clearing of survey lines).
BOARD:	Montana BOARD of Natural Resources and Conservation.
CONTRACTOR:	Constructors of the Facility (agent of owner).
DFWP:	Montana Department of Fish, Wildlife, and Parks.
DHES:	Montana Department of Health and Environmental Sciences.
DNRC:	Montana Department of Natural Resources and Conservation.
DOT:	Montana Department of Transportation.
DSL:	Montana Department of State Lands.
EXEMPT FACILITY:	A facility meeting the requirements of 75-20-202, MCA and accompanying rules.
LANDOWNER:	The owner of private property or the MANAGING AGENCY for public lands.
MANAGING AGENCY:	State or federal agency with primary responsibility for managing a specific land area.
OWNER:	The owner(s) of the facility, or the owner's agent.
SENSITIVE AREA:	Area which exhibits environmental characteristics that may make them susceptible to impact from construction of a transmission facility. The extent of these areas are defined for each project but may include any of the areas listed in 36.7.2533 or 36.7.2534, ARM as "sensitive areas" or "areas of concern."
SHPO:	State Historic Preservation Office.
STATE CONSTRUCTION INSPECTOR:	Person or persons designated by DNRC to monitor reclamation and operation of the facility for compliance with the conditions of BOARD approval.

INTRODUCTION

This document contains measures identified by DNRC for minimizing the impacts of the proposed Noranda 230-kV transmission line project. Additional site-specific measures will be identified as necessary, based on a review of final design. Any measures deemed necessary as a result of this review will be attached as Attachment A: Sensitive Area Requirements.

The purpose of these specifications is to ensure mitigation of environmental impacts during the construction, operation, and maintenance of a transmission facility. These specifications are intended to be incorporated into the texts of contract plans and specifications.

For non-exempt facilities, the Montana Major Facility Siting Act supersedes all state environmental permit requirements except for those dealing with air and water quality, public health and safety, water appropriations and diversions, and easements across

state lands (75-20-103 and 401, MCA). A major purpose of these specifications is to ensure that the intent of the laws which are superseded is met, even though the procedures of applying for and obtaining permits from various state agencies are not. As specified later in this document, the State Inspector will have the responsibility for arranging reviews and inspections by other state agencies which would otherwise have been done through a permit application process.

0.0 GENERAL SPECIFICATIONS

0.1 Scope

These specifications apply to all lands affected by the project. Where the LANDOWNER requests practices other than those listed in these specifications, the OWNER may authorize such a change provided that the STATE INSPECTOR is notified in writing of the change and that the change would not be in violation of: (1) the intent of any state law which is superseded by the Montana Major Facility Siting Act; (2) the Certificate; (3) any conditions imposed by the BOARD; or (4) the BOARD's finding of minimum adverse impact; or (5) the regulations in 36.7.5501 and 5502, ARM.

0.2 Environmental Protection

The OWNER shall conduct all operations in a manner to protect the quality of the environment and to reduce impacts to the greatest extent practical. It is the intent of these measures to incorporate and apply "best management practices" during construction, post construction, operation, and decommissioning of the facility.

0.3 Contract Documents

These specifications shall be part of or incorporated into the contract documents; therefore, the OWNER and the OWNER's agents shall be held responsible for adherence to these specifications in performing the work.

0.4 Briefing Employees

The OWNER shall ensure that the CONTRACTOR and all field supervisors are provided with a copy of these specifications and informed of which sections are applicable to specific procedures. It is the responsibility of the OWNER, its CONTRACTOR, and CONSTRUCTION SUPERVISORS to ensure that the intent of these measures are met. Supervisors shall inform all employees on the applicable environmental constraints spelled out herein prior to and during construction. Site-specific measures spelled out in the addendums attached hereto shall be incorporated into the design and construction specifications or other appropriate contract document.

0.5 Compliance with Regulations

All project-related activities of the OWNER shall comply with all applicable local, state, and federal laws, regulations, and requirements.

0.6 Limits of Liability

The OWNER is not responsible for correction of environmental damage or destruction of property caused by negligent acts of DNRC employees during construction monitoring activities.

0.7 Designation of Sensitive Areas

DNRC, in its evaluation of the project, has designated certain areas along the right-of-way or access roads as SENSITIVE AREAS. The OWNER shall take all reasonable actions to avoid adverse impact in these SENSITIVE AREAS. (see Attachment A).

0.8 Performance Bonds

To ensure compliance with these specifications, the OWNER shall submit to the State of Montana or its authorized agent a BOND or bonds pertaining specifically to the restoration of the right-of-way and adjacent land damaged during construction. Post-

construction monitoring by DNRC will determine compliance with these specifications and other mitigating measures included herein. At the time cleanup and restoration are complete, and revegetation is progressing satisfactorily, the OWNER shall be released from his obligation for restoration. At the time the OWNER is released, a portion of this BOND or a separate BOND shall be established by the OWNER and submitted to the State of Montana or its authorized agent. This BOND shall be held for five years or until monitoring by DNRC indicates that reclamation and road closures have been adequate. The amount and bonding mechanisms for this section shall be agreed to by the BOARD and OWNER under provisions established by 36.7.4006(2), ARM. The amounts of BOND or BONDS shall be specified in Addendum B and attached. Proof of bond shall be submitted to DNRC.

0.9 Designation of Structures

Each structure for the project shall be designated by a unique number on plan and profile maps. If this information is not available because the survey is not complete, locations along the centerline shall be indicated by station numbers or mileposts. Station numbers or mileposts of all angle points shall be designated on plan and profile maps. References to specific poles or towers in communication between the OWNER and DNRC shall use these numbers.

0.10 Access

When easements for construction access are obtained for construction personnel, provision will be made by the OWNER to ensure that the STATE INSPECTOR assigned by DNRC will be allowed access to the right-of-way, including the use of any off-right-of-way access roads used during the term of the BOND(s) required by 36.7.4006(2), ARM. Liability for damage caused by providing such access for the STATE INSPECTOR shall be limited by Section 0.6, Limits of Liability.

0.11 Designation of State Inspector

DNRC shall designate a STATE INSPECTOR or INSPECTORS to monitor the OWNER's compliance with these specifications and any other project-specific mitigation measures adopted by the BOARD as provided in 36.7.5502(1), ARM. The STATE INSPECTOR shall be the OWNER's liaison with the State of Montana on construction, post-construction, and reclamation activities. All communications regarding the project shall be directed to the STATE INSPECTOR. The name of the STATE INSPECTOR can be obtained by contacting the Administrator of the Energy Division, DNRC.

1.0 PRECONSTRUCTION PLANNING AND COORDINATION

1.1 Planning

1.1.1 Planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts will be kept to a minimum. The CONTRACTOR and OWNER shall, to the extent possible, plan the timing of construction, construction and maintenance access and requirements, location of special use sites, and other details before the commencement of construction.

1.1.2 Preferably 45 days, but at least 30 days before the start of construction, the OWNER shall submit plan and profile map(s) depicting the location of the centerline and of all construction access roads, maintenance access roads, structures, clearing backlines, and, if known, special use sites. The scale of the map shall be 1:24,000 or larger. Specifications and typical sections for construction and maintenance access roads shall be submitted with the plan and profile map(s). When these materials are submitted, access road locations shall have been flagged on-the-ground for review by the STATE INSPECTOR.

1.1.3 If special use sites are not known at the time of submittal of the plan and profile, the following information shall be submitted no later than five days prior to the start of construction. The location of special use sites, including staging sites, pulling sites, batch plant sites, splicing sites, borrow pits, campsites, and storage or other buildings, shall be plotted on one of the following and submitted to the Department: ortho photomosaics of a scale 1:24,000 or larger, available USGS 7.5' plan and profile maps of a scale 1:24,000 or larger.

1.1.4 Changes or updates to the information submitted in 1.1.2 and 1.1.3 shall be submitted to DNRC as they become available. In no case shall a substantive change be submitted less than fifteen days prior to its anticipated date of construction. Changes in these locations prior to construction (where designated SENSITIVE AREAS are affected), must be submitted to DNRC 15 days before construction and approved by the STATE INSPECTOR prior to construction.

1.1.5 Long-term maintenance routes to all points on the line should be planned before construction begins. Where known, new construction access roads intended to be maintained for permanent use shall be differentiated from temporary access roads on the maps required under 1.1.2 above.

1.2 Preconstruction Conference

1.2.1 At least one week before commencement of any construction activities, the OWNER shall schedule a preconstruction conference. The STATE INSPECTOR shall be notified of the date and location for this meeting. One of the purposes of this conference shall be to brief the CONTRACTOR and land management agencies regarding the content of these specifications and other BOARD-approved mitigating measures, and to make all parties aware of the roles of the STATE INSPECTOR and of the federal inspectors (if any).

1.2.2 The OWNER's representative, the CONTRACTOR's representative, the STATE INSPECTOR, and representatives of affected state and federal agencies who have land management or permit and easement responsibilities shall be invited to attend the preconstruction conference.

1.3 Public Contact

1.3.1 Written notification by the OWNER's field representative or the CONTRACTOR shall be given to local public officials in each affected community prior to the beginning of construction to provide information on the temporary increase in population, when the increase is expected, and where the workers will be stationed.

1.3.2 The OWNER shall negotiate with the LANDOWNER in determining the best locations for access easements and the need for gates.

1.3.3 The OWNER shall contact local government officials, or the MANAGING AGENCY as appropriate, regarding implementation of required traffic safety measures.

1.4 Historical and Archaeological Surveys

1.4.1 The OWNER must develop and carry out a plan approved by DNRC that includes steps which have been and will be taken to identify, evaluate, and avoid or mitigate damage to cultural resources affected by the project. The plan shall include: (1) actions taken to identify cultural resources during initial intensive survey work; (2) an evaluation of the significance of the identified sites and likely impacts caused by the project; (3) recommended treatments or measures to avoid or mitigate damage to known cultural sites; (4) steps to be taken in the event other sites are identified after approval of the plan; and (5) provisions for monitoring construction to protect cultural resources. Except for monitoring, all steps of the plan must be carried out prior to the start of construction. The requirement for this plan should not be construed to exempt or alter compliance by the OWNER or MANAGING AGENCY with 36 CFR 800. However, compliance with 36 CFR 800 can be

used to satisfy the requirements included in this section.

2.0 CONSTRUCTION

2.1 General

2.1.1 The preservation of the natural landscape contours and environmental features shall be an important consideration in the location of all construction facilities, including roads, storage areas, and buildings. Construction of these facilities shall be planned and conducted so as to minimize destruction, scarring, or defacing of the natural vegetation and landscape. Any necessary earthmoving shall be planned and designed to be as compatible as possible with the natural land forms.

2.1.2 Temporary construction sites and staging areas shall be kept to the minimum size necessary to perform the work. Such areas shall be located where most environmentally compatible, considering slope, fragile soils or vegetation, and risk of erosion. After construction, these areas shall be restored as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the STATE INSPECTOR.

2.1.3 All work areas shall be maintained in a neat, clean, and sanitary condition at all times. Trash or construction debris (in addition to solid waste described in Section 2.14) shall be regularly removed during the construction and reclamation periods.

2.1.4 Vegetation such as trees, plants, shrubs, and grasses on or adjacent to the right-of-way which do not interfere with the performance of construction work or operation of the line itself shall be preserved.

2.1.5 The OWNER shall take all necessary action to avoid adverse impacts to SENSITIVE AREAS listed in Addendum A. The STATE INSPECTOR shall be notified two working days in advance of initial clearing or construction activity in these areas. The OWNER shall mark or flag the clearing backlines and limits of disturbance in certain SENSITIVE AREAS as designated in Addendum A or required by the STATE INSPECTOR. All construction activities must be conducted within marked areas.

2.1.6 The OWNER shall either acquire appropriate land rights or provide compensation for damage for the land area that will be disturbed by construction. The width of the area disturbed by construction shall not exceed a reasonable distance from the centerline as necessary to perform the work. For this project, construction activities should be contained within the area specified on the plan and profile maps approved by the STATE INSPECTOR as provided for in General Specification number 0.9.

2.1.7 Except for Sedlak Creek, flow in a streamcourse may not be permanently diverted. If temporary diversion is necessary, flow will be restored before a major runoff season or the next spawning season, as determined by the STATE INSPECTOR in consultation with the MANAGING AGENCY (see 2.11.6).

2.2 Construction Monitoring

2.2.1 The STATE INSPECTOR is responsible for implementing the monitoring plan required by 36.7.5501 and 5502, ARM. The plan consists of those actions necessary to determine compliance with the terms and conditions of the BOARD's approval and to be consistent with applicable BOARD standards contained in Administrative Rules or BOARD Order.

2.2.2 The STATE INSPECTOR may require mitigation measures or procedures at some sites beyond those listed in Addendum A in order to minimize environmental damage due to unique circumstances that arise during construction. Unique circumstances would include unanticipated discovery of a cultural site or active sensitive raptor nest, and situations when construction activities will cause excessive environmental impacts due to seasonal field conditions. The STATE INSPECTOR will

require appropriate mitigating measures or minor construction rescheduling to avoid these impacts. The STATE INSPECTOR will provide the OWNER with written documentation of the reasons for the modifications within 24 hours of their imposition.

2.2.3 In the event that the STATE INSPECTOR shows reasonable cause that compliance with the BOARD conditions or these specifications is not being achieved, DNRC would take appropriate corrective action as provided in 36.7.5502(12), ARM.

2.3 Timing of Construction

2.3.1 Construction and motorized travel may be restricted or prohibited at certain times of the year in certain areas. Exemptions to these timing restrictions may be granted by DNRC in writing if the OWNER can clearly demonstrate that no environmental impacts will occur as a result. These areas, listed in Addendum A, include areas deemed as sensitive areas and areas of concern in 36.7.2533 or 36.7.2534, ARM.

2.3.2 In order to prevent rutting and excessive damage to vegetation, construction will not take place during periods of high soil moisture when construction vehicles will cause severe rutting requiring extensive reclamation.

2.4 Public Safety

2.4.1 All construction activities shall be done in compliance with existing health and safety laws.

2.4.2 Requirements for aeronautical hazard marking shall be determined by the OWNER in consultation with the Montana Aeronautical Division, the FAA, and DNRC. Where required, aeronautical hazard markings shall be installed at the earliest practical time following stringing of the wires.

2.4.3 Noise levels shall not exceed established BOARD standards as a result of operation of the facility and associated facilities. For electric transmission facilities, the average annual noise levels, as expressed by an A-weighted day-night scale (Ldn), will not exceed (a) 50 decibels at the edge of the right-of-way in residential and subdivided areas unless the affected LANDOWNER waives this condition, and (b) 55 decibels at the edge of property boundaries of substations in residential and subdivided areas.

2.4.4 The facility shall be designed, constructed, and operated to adhere to the National Electric Safety Codes regarding transmission lines.

2.4.5 The electric field at the edge of the right-of-way will not exceed 1 kilovolt per meter measured 1 meter above the ground in residential or subdivided areas unless the affected LANDOWNER waives this condition, and that the electric field at road crossings under the facility will not exceed 7 kilovolts per meter measured 1 meter above the ground.

2.5 Protection of Property

2.5.1 Construction operations shall not take place over or upon the right-of-way of any railroad, public road, public trail, or other public property until negotiations and/or necessary approvals have been completed with the MANAGING AGENCY. Where it is necessary to cross a trail with access roads, the trail corridor will be restored. Adequate signing and/or blazes will be established so the user can find the route. All roads and trails designated by government agencies as needed for fire protection or other purposes shall be kept free of logs, brush, and debris resulting from operations under this agreement. Any such road or trail damaged by this project shall be promptly restored as nearly as possible to its original condition.

2.5.2 Reasonable precautions shall be taken to protect, in place, all public land monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, the marker shall be re-established and referenced in accordance with the procedures outlined in the "Manual of Instruction for the Survey of the Public Land of the United States" or, in the case of private

property, the specifications of the county engineer. Re-establishment will be at the expense of the OWNER.

2.5.3 Construction shall be conducted so as to prevent any damage to existing real property including transmission lines, distribution lines, telephone lines, railroads, ditches, and public roads crossed. If such property is damaged by operations under this agreement, the OWNER shall repair such damage immediately to a reasonable satisfactory condition in consultation with the property owner.

2.5.4 In areas with livestock, the OWNER shall make a reasonable effort to comply with the reasonable requests of LANDOWNERS regarding measures to control livestock. Care shall be taken to ensure that all gates are reclosed after entry or exit and the LANDOWNER shall be compensated for any losses to personal property due to construction or maintenance activities. Gates shall be inspected and repaired when necessary during construction and missing padlocks shall be replaced. The OWNER shall ensure that gates are not left open at night or during periods of no construction activity. Any fencing or gates cut, removed, damaged, or destroyed by the OWNER shall immediately be replaced with new materials. Fences installed shall be of the same height and general type as the fence replaced or nearby fence on the same property, and shall be stretched tight with a fence stretcher before stapling or securing to the fence posts. Temporary gates shall be of sufficiently high quality to withstand repeated opening and closing during construction to the satisfaction of the STATE INSPECTOR.

2.5.5 The CONTRACTOR must notify the OWNER, the STATE INSPECTOR, and, if possible, the affected LANDOWNER within two working days of damage to land, crops, property, or irrigation facilities, contamination or degradation of water, or livestock injury caused by the OWNER's construction activities. The OWNER shall reasonably restore any damaged resource or property or provide reasonable compensation to the affected party.

2.5.6 Pole holes and anchor holes must be covered or fenced in any fields, pastures, or ranges used for livestock grazing or where a LANDOWNER's requests can be reasonably accommodated.

2.5.7 All fences crossed by permanent access roads shall be provided with a gate or other suitable closure to the satisfaction of the STATE INSPECTOR. All fences to be crossed by access roads shall be braced before the fence is cut. Fences not to be gated should be restrung temporarily during construction and permanently within 30 days following construction, subject to the reasonable desires of the LANDOWNER.

2.5.8 Where new access roads cross fence lines, the OWNER shall make reasonable effort to accommodate the LANDOWNER's wishes on gate location and width.

2.5.9 Any breaching of natural barriers to livestock movement by construction activities will require fencing sufficient to control livestock.

2.6 Traffic Control

2.6.1 At least 30 days before any construction within or over any state or federal highway right-of-way, the OWNER will notify the appropriate DOT field office to review the proposed occupancy and to resolve any problems. The OWNER must supply DNRC with documentation that this consultation has occurred This documentation should include any measures recommended by DOT and to what extent the OWNER has agreed to comply with these measures. In the event that recommendations or regulations were not followed, a statement as to why the OWNER chose not to follow them should be included.

2.6.2 In areas where the construction created a hazard, traffic will be controlled according to the applicable DOT regulations. Safety signs advising

motorists of construction equipment shall be placed on major state highways, as recommended by DOT. The installation of proper road signing will be the responsibility of the OWNER.

2.6.3 The MANAGING AGENCY shall be notified, as soon as practicable, when it is necessary to close public roads to public travel for short periods to provide safety during construction.

2.6.4 Construction vehicles and equipment will be operated at speeds safe for existing road and traffic conditions.

2.6.5 Traffic delays will be restricted on primary access routes, as determined by DOT or the MANAGING AGENCY.

2.6.6 Access for fire and emergency vehicles will be provided for at all times.

2.6.7 Public travel through and use of active construction areas shall be limited at the discretion of the MANAGING AGENCY.

2.7 Access Roads and Vehicle Movement

2.7.1 Construction of new roads shall be held to the minimum reasonably required to construct and maintain the facility. State, county, and other existing roads shall be used for construction access wherever possible. Access roads intended to be permanent should be initially designed as such. The location of access roads and towers shall be established in consultation with affected LANDOWNERS and LANDOWNER concerns shall be accommodated where reasonably possible and not in contradiction to these specifications or other BOARD conditions.

2.7.2 All new roads, both temporary and permanent, shall be constructed with the minimum possible clearing and soil disturbance to minimize erosion, as specified in Section 2.11 of these specifications.

2.7.3 Where practical, all roads shall be initially designed to accommodate one-way travel of the largest piece of equipment that will eventually be required to use them; road width shall be no wider than necessary.

2.7.4 Roads shall be located in the right-of-way insofar as possible. Travel outside the right-of-way to enable traffic to avoid cables and conductors during conductor stringing shall be kept to the minimum possible. Road crossings of the right-of-way should be near support structures.

2.7.5 Where practical, temporary roads shall be constructed on the most level land available. Where temporary roads cross flat land, they shall not be graded or bladed unless necessary, but will be flagged or otherwise marked to show their location and to prevent travel off the roadway.

2.7.6 In order to minimize soil disturbance and erosion potential, no cutting and filling for access road construction shall be allowed in areas of up to 5 percent sideslope. In areas of over 5 percent sideslope, road building that may be required shall conform to a 4 percent outslope. The roads shall be constructed to prevent channeling of runoff, and shoulders or berms that would channel runoff shall be avoided.

2.7.7 The OWNER will maintain all permanent access roads, including drainage facilities, which are constructed for use during the period of construction. In the event that a road would be left in place, the OWNER and LANDOWNER may enter agreements regarding maintenance for erosion control following construction.

2.7.8 Any use damage to existing private roads, including rutting, resulting from construction operation shall be repaired and restored to condition as good or better than original as soon as possible. Repair and restoration should be accomplished during and following construction as necessary to reduce erosion.

2.7.9 All permanent access road surfaces, including those under construction, will be prepared with the necessary erosion control practices as

determined by the STATE INSPECTOR or the MANAGING AGENCY prior to the onset of winter.

2.7.10 Any necessary snow removal shall be done in a manner to preserve and protect road signs and culverts, to ensure safe and efficient transportation, and to prevent excessive erosion damage to roads, streams, and adjacent land.

2.7.11 At the conclusion of line construction, final maintenance will be performed on all existing private roads used for construction access by the CONTRACTOR. These roads will be returned to a condition as good or better than when construction began.

2.7.12 At least 30 days prior to construction of a new access road approach intersecting a state or federal highway, or of any structure encroaching upon a highway right-of-way, the OWNER shall submit to DOT a plan and profile map showing the location of the proposed construction. At least five days prior to construction, the OWNER shall provide the STATE INSPECTOR written documentation of this consultation and actions to be taken by the OWNER as provided in 2.6.1.

2.8 Equipment Operation

2.8.1 During construction, unauthorized cross-country travel and the development of roads other than those approved shall be prohibited. The OWNER shall be liable for any damage, destruction, or disruption of private property and land caused by his construction personnel and equipment as a result of unauthorized cross-country travel and/or road development.

2.8.2 To prevent excessive soil damage in areas where a graded roadway has not been constructed, the limits and locations of access for construction equipment and vehicles shall be clearly marked or specified at each new site before any equipment is moved to the site. Construction foremen and personnel should be well versed in recognizing these markers and shall understand the restriction on equipment movement that is involved.

2.8.3 Dust control measures shall be implemented on access roads where required by the MANAGING AGENCY or where dust would pose a nuisance to residents. Construction activities and travel shall be conducted to minimize dust. Water, straw, wood chips, dust palliative, gravel, combinations of these, or similar control measures may be used. Oil or similar petroleum derivatives shall not be used.

2.8.4 Work crew foremen shall be qualified and experienced in the type of work being accomplished by the crew they are supervising. Earthmoving equipment shall be operated only by qualified, experienced personnel. Correction of environmental damage resulting from operation of equipment by inexperienced personnel will be the responsibility of the OWNER. Repair of damage to a condition reasonably satisfactory to the LANDOWNER, MANAGING AGENCY, or, if necessary, DNRC would be required.

2.8.5 Sock lines will be strung using a helicopter to minimize disturbance of soils and vegetation.

2.8.6 Following construction in areas designated by the local weed control board as noxious weed areas, the CONTRACTOR shall thoroughly clean all vehicles and equipment to remove weed parts and seeds immediately prior to leaving the area.

2.9 Right-of-Way Clearing and Site Preparation

2.9.1 The STATE INSPECTOR shall be notified at least 10 days prior to any timber clearing.

2.9.2 During clearing of survey lines or the right-of-way, shrubs shall be preserved to the greatest extent possible. Shrub removal shall be limited to crushing where possible or cutting where necessary. Plants may be cut off at ground level, leaving roots undisturbed so that they may resprout.

2.9.3 Right-of-way clearing shall be kept to the minimum necessary to meet the requirements of the National Electric Safety Code. Trees to be saved

within the clearing backlines and danger trees located outside the clearing backlines shall by marked. Clearing backlines in SENSITIVE AREAS will be indicated on plan and profile maps. All snags and old growth trees that do not endanger the line or maintenance equipment shall be preserved. In designated SENSITIVE AREAS, the STATE INSPECTOR shall approve clearing boundaries prior to clearing.

2.9.4 In no case should the entire nominal width of the right-of-way be cleared of trees up to the edge, unless approved by the STATE INSPECTOR and the LANDOWNER. Clearing should instead produce a "feathered edge" right-of-way configuration, where only specified hazard trees and those that interfere with construction or conductor clearance are removed. In areas where there is potential for long tunnel views of transmission lines or access roads as described in Addendum A, special care shall be taken to screen the lines from view. Where appropriate, special care shall be taken to leave a separating screen of vegetation where the right-of-way parallels or crosses highways and rivers.

2.9.5 During construction, care will be taken to avoid damage to small trees and shrubs on the right-of-way that do not interfere with the clearing requirements under Section 2.9.3 and would not grow to create a problem over a 10-year period.

2.9.6 Soil disturbance and earthmoving will be kept to a minimum. Clearing and site preparation activities shall be conducted consistent with the measures described in Section 2.11, Erosion and Sediment Control.

2.9.7 The OWNER shall be held liable for any unauthorized cutting, injury, or destruction to timber whether such timber is on or off the right-of-way.

2.9.8 Unless otherwise requested by the LANDOWNER or MANAGING AGENCY, felling shall be directional in order to minimize damage to remaining trees. Maximum stump height shall be no more than 12 inches on the uphill side or 1/3 the tree diameter, whichever is greater. Trees will not be pushed or pulled over. Stumps will not be removed unless they conflict with a structure, anchor, or roadway.

2.9.9 Special logging, clearing, or excavation techniques may be required in certain highly sensitive or fragile areas.

2.9.10 Crane landings shall be constructed with minimum disturbance considering the conditions present at each pole site. The STATE INSPECTOR shall review areas proposed foe disturbance based on the plan and profile an may require that disturbance be limited in identified SENSITIVE AREAS. The STATE INSPECTOR will be notified at least five days prior to the beginning of construction at those sites.

2.9.11 No motorized travel on, scarification of, or displacement of talus slopes shall be allowed except where approved by the STATE INSPECTOR and LANDOWNER or MANAGING AGENCY.

2.9.12 To avoid unnecessary ground disturbance, counterpoise should be placed or buried in disturbed areas whenever possible.

2.9.13 Slash resulting from project clearing that may be washed out by high water the following spring shall be removed and piled outside the floodplain before runoff. Instream slash resulting from project clearing must be removed within 24 hours.

2.9.14 Streamside trees will be felled away from streams rather than into or across streams.

2.10 Grounding

2.10.1 Grounding of fences, buildings, and other structures on and adjacent to the right-of-way shall be done according to the specifications of the National Electric Safety Code.

2.11 Erosion and Sediment Control

2.11.1 Clearing and grubbing for roads and rights-of-way, at stream crossings, and other areas of surface disturbance shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. Erosion control measures contained in the Soil and Water Conservation Handbook (KNF) shall be used to minimize erosion and sediment problems and will be required as appropriate following review of the plan and profile map(s) required under Section 0.9.

2.11.2 Roads shall cross drainage bottoms at sharp or nearly right angles and level with the streamed whenever possible. Temporary bridges, fords, culverts, or other structures to avoid stream bank damage will be installed.

2.11.3 Under no circumstances shall streamed materials be removed for use as backfill, embankments, road surfacing, or for other construction purposes.

2.11.4 No excavations shall be allowed on any river or perennial stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

2.11.5 Installation of culverts, bridges, or other structures in perennial streams will be done in accordance with Section 2.11.11 following on-site inspections by the STATE INSPECTOR. All culverts shall be installed with the culvert inlet and outlet at natural stream grade or ground level. Water velocities or positioning of culverts shall not impair fish passage.

2.11.6 Following submittal of plan and profile maps, but prior to construction of access roads, bridges, fill slopes, culverts, or impoundments, or channel changes within the high-water mark of any perennial stream, lake, or pond, the OWNER shall discuss proposed activities with the STATE INSPECTOR, DFWP, local conservation district, and KNF personnel. This site review will determine the specific mitigation measures to minimize impacts appropriate to the conditions present.

2.11.7 No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to protect the stream from debris and from entry of nitrates or other contaminants in the stream.

2.11.8 The OWNER shall maintain private roads while using them. All ruts made by machinery shall be filled or graded to prevent channeling. In addition, the OWNER must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include, but are not limited to, installing or using cross logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these.

2.11.9 The OWNER shall prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep excavated materials and other extraneous materials out of watercourses. Any such materials entering watercourses shall be removed immediately.

2.11.10 The OWNER shall be responsible for the stability of all embankments created during construction. Embankments and backfills shall contain no stream sediments, frozen material, large roots, sod, or other materials which may reduce their stability.

2.11.11 Culverts, arch bridges, or other stream crossing structures shall be installed at all permanent crossings of flowing or dry watercourses where fill is likely to wash out during the life of the road. Culvert or bridge installation is prohibited in areas of important fish spawning beds identified by DFWP and during specified fish spawning seasons on less sensitive streams or rivers. All culverts shall be sized according to KNF guidelines as found in the Revised Hydraulic Guide, Kooteni National Forest

(1985) and Amendments. All culverts shall be installed at the time of road construction.

2.11.12 No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

2.11.13 No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads.

2.11.14 No perennial watercourses shall be permanently blocked or diverted.

2.11.15 Skidding with tractors shall not be permitted within 100 feet of streams containing flowing water except in places designed in advance, and in no event shall skid roads be located on these streamcourses. Skid trails shall be located high enough out of draws, swales, and valley bottoms to permit diversion of runoff water to natural undisturbed forest ground cover.

2.11.16 Construction methods shall prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Catchment basins capable of containing the maximum accidental spill shall be installed at areas where fuel, chemicals, or oil are stored. Any accidental spills of such materials shall be cleaned up immediately.

2.11.17 To reduce the amount of sediment entering streams, a strip of undisturbed vegetation will be provided between areas of disturbance (road construction or tower construction) and streamcourses, and around first-order or larger streams that have a well defined streamcourse or aquatic or riparian vegetation, unless otherwise required by the LANDOWNER. Buffer strip width is measured from the high water line of a channel and will be as determined by the STATE INSPECTOR and MANAGING AGENCY. For braided streams with more than one discernible channel (ephemeral or permanent), the high water line of the outermost channel is used. In the event that vegetation cannot be left undisturbed, structural sediment containment, approved by the STATE INSPECTOR, must be substituted before soil disturbing activity commences.

2.11.18 When no longer needed, all temporary structures or fill installed to aid stream crossing shall be removed and the course of the stream re-established to prevent future erosion.

2.11.19 All temporary dams built on the right-of-way shall be removed after line construction unless otherwise approved by the STATE INSPECTOR. Dams allowed to remain shall be upgraded to permanent structures and shall be provided with spillways or culverts and with a continuous sod cover on their tops and downstream slopes. Spillways may be protected against erosion with riprap or equivalent means.

2.11.20 Damage resulting from erosion or other causes shall be repaired after completion of grading and before revegetation is begun.

2.11.21 Point discharge of water will be dispersed in a manner to avoid erosion or sedimentation of streams.

2.11.22 Riprap or other erosion control activities will be planned based on possible downstream consequences of activity, and during the low flow season if possible.

2.11.23 Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete life cleanup, and other waste water processes shall not be discharged into surface waters without a valid discharge permit from DHES.

2.12 Archaeological, Historical and Paleontological Resources

2.12.1 All construction activities shall be conducted so as to prevent damage to significant archaeological, historical, or paleontological resources.

2.12.2 Any relics, artifacts, fossils, or other items of historical, paleontological, or archaeological value shall be preserved in a manner agreeable to both the LANDOWNER and the State Historic Preservation Officer. If any such items are discovered during construction, the STATE INSPECTOR shall be notified immediately. Work which could disturb the materials or surrounding area must cease until the site can be properly evaluated by a qualified archaeologist (employed by the OWNER, representing SHPO, or KNF). For significant sites, recommendations will be made by the qualified archeologist. The STATE INSPECTOR or KNF may require that reasonable measures be followed to protect significant sites.

2.12.3 The OWNER shall conform to treatments approved for significant cultural sites by KNF, Montana State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (ACHP).

2.13 Prevention and Control of Fires

2.13.1 Burning, fire prevention, and fire control shall meet the requirements of the MANAGING AGENCY and/or the fire control agencies having jurisdiction. The STATE INSPECTOR shall be invited to attend all meetings with these agencies to discuss or prepare these plans. A copy of any plans developed shall be provided to the STATE INSPECTOR.

2.13.2 The OWNER shall direct the CONTRACTOR to comply with regulations of any county, town, state, or governing municipality having jurisdiction regarding fire laws and regulations.

2.13.3 Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

2.13.4 The OWNER shall direct the CONTRACTOR to properly store and handle combustible material which could create objectionable smoke, odors, or fumes. The OWNER shall direct the CONTRACTOR not to burn refuse such as trash, rags, tires, plastics, or other debris, except as permitted by the county, town, state, or governing municipality having jurisdiction.

2.14 Waste Disposal

2.14.1 The OWNER shall direct the CONTRACTOR to use licensed solid waste disposal sites. Inert materials (Group III wastes) may be disposed of at Class III landfill sites; mixed refuse (Group II wastes) must be disposed of at Class II landfill sites.

2.14.2 Emptied pesticide containers or other chemical containers must be triple rinsed to render them acceptable for disposal in Class II landfills or for scrap recycling pursuant to ARM 16.44.202(12) for treatment or disposal. Pesticide residue and pesticide containers shall be disposed of in accordance with ARM 16.20.633(9).

2.14.3 All waste materials constituting a hazardous waste defined in ARM 16.44.303, and wastes containing any concentration of polychlorinated biphenlyls, must be transported to an approved designated hazardous waste management facility (as defined in ARM 16.44.202(12)) for treatment or disposal.

2.14.4 All used oil shall be hauled away and recycled or disposed of in a licensed Class II landfill authorized to accept liquid wastes or in accordance with Sections 2.14.2 and 2.14.3 above. There shall be no intentional release of crankcase oil or other toxic substances into streams or soil. In the event of an accidental spill into a waterway, the substances

will be cleaned up and the Water Quality Bureau, DHES, will be contacted immediately.

2.14.5 Sewage shall not be discharged into streams or streambeds. The OWNER shall direct the CONTRACTOR to provide refuse containers and sanitary chemical toilets convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local health laws and regulations.

2.14.6 In order to reduce fire hazard, small trees and brush cut during construction should be chipped, burned, and/or scattered. Slash 3 inches in diameter or greater may be scattered in quantities of up to 15 tons/acre unless otherwise requested by the LANDOWNER. Tops, limbs, and brush less than 3 inches in diameter and 3 feet in length may be left in quantities less than 3 tons per acre except on cropland and residential land or where otherwise specified by the LANDOWNER. In certain cases, the STATE INSPECTOR will authorize chipping and scattering of tops, limbs, and brush in excess of 3 tons per acre as an erosion control measure. Merchantable timber should be decked and removed at the direction of the LANDOWNER or MANAGING AGENCY.

2.14.7 Refuse burning shall require the prior approval of the LANDOWNER and a Montana Open Burning Permit must be obtained from MDHES.

2.15 Special Measures

2.15.1 Poles with a low reflectivity constant should be used to reduce potential for visual contrast.

2.15.2 Crossings of rivers should be at right angles. Strategic placement of structures should be done as a means to screen views of the transmission line and to minimize the need for vegetation clearing.

2.15.3 Based on the analysis contained in the EIS and findings made by the BOARD, general mitigations also may apply to construction and operation of the project these measure are found in Attachment.

3.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

3.1 Cleanup

3.1.1 All litter resulting from construction is to be removed, to the satisfaction of the STATE INSPECTOR, from the right-of-way and along access roads leading to the right-of-way. Such litter shall be legally disposed of as soon as possible, but in no case later than within 60 days of completion of wire clipping. If requested by the LANDOWNER, the OWNER shall provide for removal of any additional construction-related debris discovered after this initial cleanup.

3.1.2 Insofar as practical, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical, in consultation with the LANDOWNER.

3.2 Restoration, Reclamation, and Revegetation

3.2.1 Restoration, reclamation, and revegetation of the right-of-way, access roads, crane pads, splicing or stringing sites, borrow sites, gravel, fill, stone, aggregate excavation, or any other disturbance shall be consistent with the Reclamation and Revegetation Standards and provisions contained in 36.7.5502(10), ARM.

3.2.2 In agricultural areas where soil has been compacted by movement of construction equipment, the OWNER shall direct the CONTRACTOR to rip the soil deep enough to restore productivity, or if complete restoration is not possible, the OWNER shall compensate the LANDOWNER for lost productivity.

3.2.3 Earth next to access roads that cross streams shall be replaced at slopes less than the normal angle of repose for the soil type involved.

3.2.4 All drainage channels shall be restored to a gradient and width which will prevent accelerated gully erosion.

3.2.5 Drive-through dips, open-top box culverts, water bars, or cross drains shall be added to roads at the proper spacing and angle as necessary to prevent erosion (see Section 2.11.11).

3.2.6 Interrupted drainage systems shall be restored.

3.2.7 Seeding prescriptions to be used in revegetation, requirements for hydroseeding, fertilizing, and mulching will be jointly determined by representatives of the OWNER, DNRC, DSL, and other involved state and federal agencies.

3.2.8 Piling and windrowing of material for burning shall use methods that will prevent significant amounts of soil from being included in the material to be burned and minimize destruction of ground cover. Non mechanized methods are recommended if necessary to minimize soil erosion and vegetation disturbance. Piles shall be located so as to minimize danger to timber and damage to ground cover when burned.

3.2.9 During restoration in areas where topsoil has been stockpiled, the site will be graded to contours approved by the STATE INSPECTOR and the topsoil replaced on the surface. The STATE INSPECTOR may waive the requirement for topsoil replacement on a site-specific basis where additional disturbance at a site would increase erosion, sedimentation, or reclamation problems.

3.2.10 Excavated material not suitable or required for backfill shall be evenly filled back onto the cleared area prior to spreading any stockpiled soil. Large rocks and boulders uncovered during excavation and not buried in the backfill will be disposed of as approved by the STATE INSPECTOR and/or the LANDOWNER.

3.2.11 Application rates and timing of seeds and fertilizer, and purity and germination rated of seed mixtures, shall be as determined in consultation with DNRC and U.S. Forest Service. Reseeding shall be done at the first appropriate opportunity after construction ends.

3.2.12 Where appropriate, hydroseeding, drilling, or other appropriate methods shall be used to aid revegetation. Mulching with straw, wood chips, or other means shall be used where necessary.

3.2.13 All temporary roads shall be reclaimed (with the concurrence of the LANDOWNER). All temporary roadways shall be graded and scarified to permit the growth of vegetation and to discourage traffic. Permanent unsurfaced roadbeds not open to public use will be revegetated as soon after use as possible unless specified otherwise by the LANDOWNER.

4.0 OPERATION AND MAINTENANCE

4.1 Right-of-Way Management and Road Maintenance

4.1.1 Maintenance of the right-of-way and permanent access roads shall provide for the protection of SENSITIVE AREAS identified prior to and during construction. Maintenance activities off the right-of-way such as along access roads will be consistent with best management practices and environmental protection measures contained in these specifications.

4.1.2 Vegetation that has been saved through the construction process and which does not pose a hazard or potential hazard to the powerline, particularly that of value to fish and wildlife, shall be allowed to grow on the right-of-way.

4.1.3 In areas other than cropland, vegetation cover shall be maintained in the areas immediately adjacent to transmission towers in cooperation with the LANDOWNER.

4.1.4 Grass cover, water bars, cross drains, and the proper slope shall be maintained on permanent access roads and service roads in order to prevent soil erosion.

4.2 Maintenance Inspection

4.2.1 The OWNER shall have responsibility to correct soil erosion or revegetation problems on the right-of-way or access roads as they become known. Appropriate corrective action will be taken where necessary. The OWNER may, through agreement with the LANDOWNER or MANAGING AGENCY, provide a mechanism to identify and correct such problems.

4.2.2 Operation and maintenance inspections using ground vehicles shall be timed so that routine maintenance will be done when access roads are firm, dry, or frozen, wherever possible.

4.3 Correction of LANDOWNER Problems

4.3.1 When the facility causes interference with radio, TV, or other stationery communication systems after the facility is energized, the OWNER will correct the interference with mechanical corrections to facility hardware, or antennas, or will install remote antennas or repeater stations, or will use other reasonable means to correct the problem.

4.3.2 The OWNER will respond to complaints of interference by investigating complaints to determine the origin of the interference. If the interference is not caused by the facility, the OWNER shall so inform the person bringing the complaint,. The OWNER shall provide the STATE INSPECTOR with documentation of the evidence regarding the source of the interference if the person brings the complaint to the STATE INSPECTOR or the BOARD.

4.4 Herbicides and Weed Control

4.4.1 Weed control, including any application of herbicides in the right-of-way, will be in accordance with applicable state and federal laws and regulations. Additional recommendations of local weed control boards and provisions of a right-of-way maintenance agreements with LANDOWNERs may be adopted so long as they are consistent with the following requirements.

4.4.2 In areas disturbed by transmission facilities, the OWNER will cooperate with LANDOWNERs in control of noxious weeds as designed by the weed control board having jurisdiction in the county crossed by the line.

4.4.3 Proper herbicide application methods will be used to keep drift and nontarget damage to a minimum.

4.4.4 Herbicides must be applied according to label specifications and in accordance with Section 4.4.1 above. Only herbicides registered in compliance with applicable federal and state laws may be applied.

4.4.5 Herbicides shall not be sprayed during heavy rains or threat of heavy rains. Vegetation buffer zones shall be left along all identifiable stream channels. Herbicides shall not be used in any public water supply watershed identified by DHES.

4.4.6 All applications of herbicides must be performed by a licensed applicator.

4.4.7 During the second and third growing seasons following the completion of restoration and reseeding, the OWNER and STATE INSPECTOR shall inspect the right-of-way and access roads for newly established stands of noxious weeds. The county weed control supervisor shall be invited to attend this inspection In the event that stands of weeds are encountered, appropriate control measures shall be taken by the OWNER.

4.5 Monitoring

4.5.1 DNRC may continue to monitor operation and maintenance activities for the life of the project in order to ensure compliance with the specifications in this section.

4.5.2 The OWNER will be responsible to DNRC for the term of the RECLAMATION BOND. After this time, the OWNER will report to individual

LANDOWNERs and managing agencies except as specified in conditions to the certificate.

5.0 DECOMMISSIONING

5.1 Notice

5.1.1 One year prior to the anticipated date for decommissioning of the certified facility, the OWNER shall notify DNRC of the plans for decommissioning. The notice shall include information regarding the removal and salvage of equipment and plans for reclamation.

5.2 Approval of Plan required

5.2.1 The OWNER shall be responsible to DNRC for complying with reclamation standards established at the time of project approval, including applicable provisions of these specifications.

APPENDIX G—PROPOSED SEDIMENT AND EROSION CONTROL BEST MANAGEMENT PRACTICES

THIS plan contains a description of Best Management Practices (BMPs) that are applicable to timber removal, road construction and other planned construction activities related to the Montanore Project. These practices may be used alone or in conjunction with each other to reduce erosion and sediment yield to streams and wetlands. Which practice or practices may be suitable to a particular situation would be determined on a site specific basis. All construction activities would be conducted with the objective of minimizing sediment discharge to streams.

The following three components for each management practice are presented—

- *Practice*
- *Objective*
- *Planning, Design and Construction Considerations*

MANAGEMENT PRACTICES FOR TIMBER REMOVAL

Practice: Erosion Prevention and Control Measures During Timber Removal Operations.

Objective: To ensure that timber removal operations are conducted to minimize soil erosion.

Planning, Design and Construction Considerations

Equipment would not be operated when ground conditions are such that excessive impacts would result. The kinds and intensity of control work done would be adjusted to ground and weather conditions and the need for controlling runoff. Erosion control work would be kept current immediately preceding expected seasonal periods of precipitation or runoff.

Practice: Erosion Control on Skid Trails During Timber Removal Operations

Objective: To protect water quality by minimizing erosion and sedimentation derived from skid trails.

Planning, Design and Construction Considerations

This practice employs preventive controls to reach the objective. Site work involves constructing cross ditches and water spreading ditches. Spacing of cross drains and construction techniques would follow standard Kootenai National Forest guidelines.

Practice: Stream Channel Protection During Timber Removal Operations

Objective: (1) To protect the natural flow of streams; (2) to provide unobstructed passage of storm flows; (3) to reduce sediment and other pollutants entering streams; and (4) to restore the natural course of any stream as soon as practicable.

Planning, Design and Construction Considerations

a. All project debris would be removed from streamcourse in a manner that would cause the least disturbance.

b. When ground skidding systems are employed, logs would be end-lined out of streamside and Riparian Areas.

c. Water bars and other erosion control structures would be located to prevent water sediment from being channeled into streamcourses, and to dissipate concentrated flows.

d. Logs or products would be fully suspended above the ground when crossing streamcourses.

Practice: Erosion Control Structure Maintenance During Timber Removal Operations

Objective: To insure that constructed erosion control structures are stabilized and working effectively.

Planning, Design and Construction Considerations

Erosion control structures are only effective when they are in good repair and stable condition. Erosion control structures would be inspected periodically during timber removal operations and at least seasonally following completion of the operation until they are stabilized or no longer needed.

MANAGEMENT PRACTICES FOR ROAD CONSTRUCTION AND MAINTENANCE

Practice: Location and Design of Roads

Objective: To locate and design roads to minimize soil and water resource impacts.

Planning, Design and Construction Considerations

a. Roads and trails would be designed based on traffic and safety requirements of anticipated use. The design would incorporate features to prevent or minimize soil movement and sedimentation as well as undue disruption of water flow.

b. Locate and design roads and trails to drain naturally by appropriate use of out-sloping or in-sloping with cross drainages and grade changes, where possible. Relief culverts and roadside ditches would be designed whenever reliance upon natural drainage would not protect the surface, excavation, or embankment. Road drainage should be channeled to effective buffer areas to maximize sediment deposition prior to reaching flowing stream courses.

Practice: Road Erosion Control Plan

Objective: To prevent, limit, and mitigate erosion, sedimentation, and resulting water quality degradation prior to the initiation of construction and maintenance activities through timely implementation of erosion control practices.

Planning, Design and Construction Considerations

Roads and trails require a variety of erosion control measures. Many erosion control practices not only protect water quality but also maintain road prism integrity, reduce maintenance costs, and improve trafficability. The location of the road or trail with respect to streams, soil characteristics, and geologic information and other site factors govern the degree of stabilization required. Stabilization usually includes a combination of practices that promotes the reestablishment of vegetation on exposed slopes, provides physical protection to exposed surfaces, prevents the downslope movement of soil, or controls road drainage.

Since a newly constructed road is most susceptible to erosion from seasonal precipitation, the timing of erosion control practices is a primary concern. Those practices that can be accomplished concurrent with road construction would be favored as a means of immediate protection of the water resource.

Prior to the start of construction, a schedule for proposed erosion control work and construction specifications would be prepared. The schedule would consider erosion control work necessary for all phases of the project.

The following items may be considered as erosion control measures when constructed in a timely manner. To maximize effectiveness, erosion control measures must be in place and functional prior to seasonal precipitation or runoff.

a. Measures to reestablish vegetation on exposed soils. this is usually accomplished by seeding suitable grass and forb species in conjunction with mulching and fertilization. In some situations, treatments may include tree seedling planting or sprigging of other woody species.

b. Measures which physically protect the soil surface from detachment or modify the topography to minimize erosion. These treatments may include the use of surface treatment or gravel on the road travelway and ditches and the use of mulches, riprap, erosion mats, and terracing on cuts, fills, and ditches. Temporary waterbars in areas of uncompleted roads and trails can be effectively utilized to reduce sedimentation.

c. Measures which physically inhibit the downslope movement of sediments to streams. These may include the use of slash filter windrows on or below the fill slopes, baled straw in ditches or below fillslopes, catch basins at culvert inlets, and sediment basin slash filter windows may be utilized in live water drainages where fish passage is not required and where peak flows are low.

d. Measures that reduce the amount of soil disturbance in or near streams. These measures may include dewatering culvert installation or other construction sites, and immediate placement of permanent culverts during road pioneering. Temporary pipes should not be allowed unless positive control of sedimentation can be accomplished during installation, use, and removal.

e. Measures that control the concentration and flow of surface and subsurface water. These may include insloping, outsloping, ditches, cross drains, under drains, trenches, etc.

Practice: Timing of Construction Activities

Objective: To minimize erosion by conduction operations during minimal runoff periods.

Planning, Design and Construction Considerations

Erosion and sedimentation are directly related to runoff. Scheduling operations during periods when the probabilities for rain and runoff are low is an important element of effective erosion control. Construction would be scheduled and conducted to minimize potential for erosion and sedimentation. Temporary erosion control measures may be required to prevent, control, and mitigate erosion and sedimentation.

In addition, it is important to keep permanent erosion control work as current as practicable with ongoing operations. Construction of drainage facilities and performance or other contract work which would contribute to the control of erosion and sedimentation would be carried out concurrent with earthwork operations ar as soon thereafter as practicable. Limitation of the amount of area being graded at a site at any one time, and minimization of the time that an area is laid bare should be considered. Erosion control work must be kept current when road construction occurs outside of the normal operation season.

Practice: Slope Stabilization and Prevention of Mass Failures

Objective: To reduce sedimentation by minimizing the chances for road-related mass failures, including landslides and embankment slumps.

Planning, Design and Construction Considerations

Road construction in steep terrain requires cutting and loading natural slopes which may lead to landslides and/or embankment failures depending on the soil strength, geology, vegetation, aspect, and groundwater regime.

Roadways may change the subsurface drainage, since the angle and height of cut and fill slopes increase the risk of instability, it is often necessary to provide subsurface drainage to avoid subsequent slope failure. Where necessary, horizontal drains, drainage trenches, or drainage blankets may be used to lower the subsurface water levels and to prevent groundwater from entering embankments.

In areas with high landslide potential, the composition and characteristics of embankments may be controlled since they are essentially engineered structures. Care must be taken to prevent the incorporation of construction slash or other organic material.

Embankment material placement should consider the following methods:

a. Layer placement.

b. Controlled compaction.

c. Controlled compaction using density controlled strips.

d. Compaction controlled with a special project specification.

Practice: Mitigation of Surface Erosion and Stabilization of Slopes.

Objective: To minimize soil erosion from road cutslopes, fillslopes, and travelway.

Planning, Design and Construction Considerations

Road construction exposes fresh, loose soil to the erosive force of wind, water, and traffic. Surface erosion from roads is greatest during the first year following construction. It is desirable to minimize erosion due to the adverse impacts on water quality, vehicle maintenance, road maintenance, and safety. Erosion can occur on cutslopes, fillslopes, and/or travelways. Each of the three surfaces has unique erosion considerations including:

Surface	General Characteristics	Stabilization-Mitigation Measures
Cutslope	Steeper, undisturbed, and more sterile soil	Vegetative and mechanical stabilization
Fillslope	Flatter, loose, and more fertile soil	Vegetative and mechanical stabilization
Travelway	Flattest, compact (due to traffice	Surface Stabilization

Vegetative measures include seeding herbaceous species (grass legumes, or browse species) or the planting of brush or trees.

Fertilization, mulching, watering, and/or erosion netting and fabrics may be required to ensure success.

Mechanical measures include construction of slash windrows, straw bale dams, erosion netting and fabrics, terraces, or benching, riprapping, tackifiers, and gunnite.

Surface stabilization includes watering, dust oiling, dust palliatives, aggregate layer, bituminous surface treatment, or asphalt paving depending on traffic, soils, and climatic factors.

An integrated system of collection control, and dispersion of concentrated surface water is very important in order to prevent erosion on fillslopes, travelways, and natural slopes below cross drains and culverts.

Practice: Control of Permanent Road Drainage

Objective: To minimize the erosive effects of concentrated water and the degradation of water quality by proper design and construction of road drainage systems and drainage control structures.

Planning, Design and Construction Considerations

Degradation of water quality by sediment and the erosive effects of surface runoff can be minimized by stabilizing the road prism and adjacent disturbed areas from erosion. Velocities in the road drainage system can be dissipated before entry into the natural system by design and construction of control structures.

A number of measures can be used alone or in combination to control the detrimental effects of road drainage. Methods used to control water and reduce erosion may include: properly spaced culverts, cross drains, water bars, rolling dips, energy dissipators, aprons, gabions, and armoring of ditches and drain inlets and outlets. Dispersal of runoff can also be accomplished by rolling the grade, insloping, outsloping, crowning, contour trenching, installation of water spreading ditches, etc.

Practice: Pioneer Road Construction

Objective: To minimize sediment production and mass associated with pioneer road construction.

Planning, Design and Construction Considerations

Pioneer roads are built to allow equipment access for construction of planned roadways. Pioneering is usually done within the corridor of the planned road. To meet the objective of minimizing sediment, the following constraints should be followed:

a. Construction of pioneer roads would be confined to the roadway disturbance limits except where safety or other considerations outweigh the benefits of this practice.

b. Pioneering would be conducted so as to prevent undercutting of the designated final cut slope, prevent avoidable deposition of materials outside the designated roadway limits, and accommodate drainage with temporary culverts or log crossings unless approved otherwise.

c. Erosion control work would be completed concurrent with construction activity or prior to the wet season.

d. Live streams crossed by pioneer roads would be dewatered by diversion devices.

Practice: Timely Erosion Control Measures on Incomplete Roads and Streamcrossing Projects

Objective: To minimize erosion of and sedimentation from disturbed ground on incomplete projects.

Planning, Design and Construction Considerations

Protective measures must be applied to all areas of disturbed, erosion-prone, unprotected ground that is not to be further disturbed in the present year. When conditions permit operations outside the Normal Operating Season, erosion control measures must be kept current with ground disturbance, to the extent that the affected area can be rapidly "closed," if weather conditions deteriorate. Areas must not be abandoned for the winter with remedial measures incomplete.

Preventive measures include:

a. The removal of temporary culverts, culvert plugs, diversion dams, or elevated streamcrossing causeways;

b. The installation of temporary culverts, side drains, flumes, cross drains, diversion ditches, energy dissipators, dips, sediment basins, berms, debris racks, or other facilities needed to control erosion;

c. The removal of debris, obstructions, and spoil material form channels and floodplains;

d. Grass seeding, planting deep rooted vegetation, and/or mulching.

Practice: Control of Road Construction Excavation and Sidecast Material

Objective: To reduce sedimentation from unconsolidated excavated and sidecast material caused by road construction, reconstruction, or maintenance.

Planning, Design and Construction Considerations

Unconsolidated material from road construction is exposed on cut and fillslopes, can be difficult to stabilize, and may represent a major sediment source. In some cases layer placement and/or benching may be necessary for stabilization and to obtain the proper dimensions and fill slope ratios. End hauling and retaining structures may be necessary to prevent thin layers of unconsolidated material from being sidecast on steep slopes where compaction is impractical. Prior to commencing construction, reconstruction, or maintenance activities, waste areas should be located where excess material can be deposited and stabilized. If waste areas

are located on steep slopes, sidecast materials should be consolidated and stabilized. Disposal of slide debris should be in areas where it can be stabilized.

Normal erosion control such as seeding should be supplemented with special mitigation measures such as jute netting, erosion cloth, mulching, slash windrows, sediment ponds, hay bale dams, silt fences and rock gabions, when such measures are determined necessary for local conditions.

Practice: Controlling In-Channel Excavation

Objective: To minimize stream channel disturbances and related sediment production.

Planning, Design and Construction Considerations

During the construction of roads and the installation, it may be necessary for construction equipment to cross, operate in, or operate near streamcourses.

Excavation during the installation of streamside structures should be accomplished in the following manner in order to protect water quality. Unless otherwise approved, no excavation would be made outside of caisson, cribs, cofferdams, or sheet piling, and the natural stream bed adjacent to the structure would not be disturbed. If any excavation or dredging is made at the site of the structure before caissons, cribs, or cofferdams are sunk in place, all such excavations would be restored to the original ground surface or the stream bed would be protected with suitable stable material. Material deposited within the stream area from foundation or other excavation would not be discharged directly into live streams but would be pumped to settling areas. Excavations for stream crossings should be started early enough in the summer so that the installation is complete before winter.

Practice: Diversion of Flows Around Construction Sites

Objective: To minimize downstream sedimentation by insuring that all stream diversions are carefully planned.

Planning, Design and Construction Considerations

Flow must sometimes be guided or piped around project sites. Typical examples are bridge and dam construction. Such a diverted flow would be restored to the natural streamcourse as soon as practicable and, in any event, prior to the major storm season or fish migration season. Stream channels impacted by construction activity would be restored to their natural grade, condition, and alignment as soon as possible.

Practice: Streamcrossing on Temporary Roads

Objective: To minimize downstream sedimentation by insuring that all stream diversions are carefully planned.

Planning, Design and Construction Considerations

Culverts, temporary bridges, low water crossings, or fords would be required on temporary roads at all locations where it is necessary to cross streamcourses. Such facilities would be designed and installed to provide unobstructed stream flow and fish passage, and to minimize damage to the streamcourse.

Channel crossing should generally be as perpendicular to streamcourses as possible. Streambank excavation would be kept to a the minimum needed for use of the crossing.

Crossing facilities would be removed when the facility has served its purpose and is no longer needed. Fills associated with these facilities would also be removed.

Practice: Bridge and Culvert Installation

Objective: To minimize sedimentation and turbidity resulting from excavation for in-channel structures.

Planning, Design and Construction Considerations

Excavation in or near streamcourses is a common requirement for the installation of bridges, culverts, and other streamside structures such as weirs, check dams, riprapping, or fish passage structures. Surplus material should not obstruct the streamcourse including the floodplain. Preventive measures include:

a. Diverting stream flow around project sites during construction in order to minimize erosion and downstream sedimentation.

b. Easily erodible material would not be deposited into live streams.

c. Any material stockpiled on floodplains would be removed before rising waters reach the stockpiled material.

d. During excavation in or near the streamcourse, it may be necessary to use suitable coffer dams, caissons, cribs or sheet piling. This would usually be the case where groundwater is contributing a significant amount of water to the immediate excavation area. If any of the aforementioned devices are used, they would be practically watertight and no excavation would be made immediately outside of them. If water from subsurface strata is not significant, pumping may be used, provided the sediment from the pumped water can be disposed of where it would not re-enter the stream during high flows.

e. Water pumped from foundation excavation would not be discharged directly into live streams, but would be pumped into settling ponds.

f. When needed, bypass roads should be located to have the minimal disturbance on the streamcourse.

Practice: Disposal of Right-of-Way and Roadside Debris

Objective: To insure that debris generated during road construction is kept out of streams and to prevent slash and debris from subsequently obstructing channels.

Planning, Design and Construction Considerations

As a preventive measure, construction debris and other newly generated slash developed along roads near streams would be disposed of by the following means as applicable:

a. On-Site
   1. Windrowing
   2. Scattering
   3. Burying
   4. Chipping
   5. Piling and burning
   6. Removal to approved disposal area

b. Large limbs and cull logs may be bucked into manageable lengths and piled alongside the road for fuelwood.

Practice: Streambank Protection

Objective: To minimize sediment production from streambanks and structural abutments in natural waterways.

Planning, Design and Construction Considerations

The stabilization of stream embankments disturbed by the construction of a water crossing or a roadway fill parallel to a streamcourse, is necessary to prevent erosion of the material during natural stream flow. To reduce sediment and channel bank degradation, it is necessary to incorporate "armoring" in the design of a structure to allow the water course to stabilize after construction. Riprap, gabion structures, and other measures are commonly used to armor stream banks and drainage ways from the erosive forces of flowing water. These measures must be sized and installed in such a way that they effectively resist erosive water velocities. Stone used for riprap should be free from weakly structured rock, soil, organic material and materials of insufficient size, all of which are not resistant to stream flow and would only serve as sediment sources. Outlets for drainage facilities in erodible soils commonly require riprapping for energy dissipation.

Practice: Maintenance of Roads

Objective: To maintain all roads in a manner which provides for soil and water resource protection by minimizing rutting, failures, sidecasting, and blockage of drainage facilities.

Planning, Design and Construction Considerations

Roads normally deteriorate because of use and weather impacts. This deterioration can be minimized through proper and timely maintenance. All project roads would be maintained to protect the road prism and surface and to insure that damage to adjacent land and water resources is held to minimum. This level of maintenance requires at a minimum an annual inspection to determine what work, if any, is needed to keep drainage functional and the road stable. Maintenance must protect drainage facilities and runoff patterns. Additional maintenance measures could include resurfacing, outsloping, clearing debris from dips and cross drains, armoring of ditches, spot rocking, and drainage improvement. Maintenance needs would be reflected in an annual road maintenance plan.

Practice: Road Surface Treatment to Prevent Loss of Materials

Objective: To minimize the erosion of road surface materials and consequently reduce the likelihood of sediment production.

Planning, Design and Construction Considerations

Unconsolidated road surface material is susceptible to erosion during precipitation events. likewise, dust derived from road use may settle onto adjacent water bodies. Road surface treatments may include water, dust oiling, penetration oiling, sealing, aggregate surfacing, chip-sealing or paving.

Practice: Snow Removal Controls

Objective: To minimize the impact of snow melt on road surfaces and embankments and to reduce the probability of sediment production resulting from snow removal operations.

Planning, Design and Construction Considerations

This is a preventive measure used to protect resources and indirectly to protect water quality. The following measures are employed to meet the objectives of this practice.

a. During snow removal operations, banks would not be undercut nor would gravel or other selected surfacing material be bladed off the roadway surface. Ditches and culverts would be kept functional during and following roadway use. If the road surface is damaged, the Purchaser would replace lost surface material with similar quality material and repair structures damaged in blading operations.

b. Snow berms would not be left on the road surface or would be placed to avoid channelization or concentration of melt water on the road or erosive slopes. Berms left on the shoulder of the road would be removed and/or drainage holes opened at the end of winter operations and before the spring breakup. Drainage

holes would be spaced as required to obtain satisfactory surface drainage without discharge on erodible fills. On insloped roads, drainage holes would also be provided on the ditch side, but care taken to insure that culverts and culvert inlets are not damaged.

GENERAL CONSTRUCTION PRACTICES

Practice: Servicing and Refueling of Equipment

Objective: To prevent contamination of waters from accidental spills of fuels, lubricants, bitumens, raw sewage, wash water, and other harmful materials.

Planning, Design and Construction Considerations

During servicing or refueling, pollutants from construction equipment may enter a watercourse. This threat is minimized by selecting service and refueling areas well away from wet areas and surface watercourses and by using berms around such sites to contain spills.

Practice: Control of Construction in Riparian Areas

Objective: To minimize the adverse effects on Riparian Areas.

Planning, Design and Construction Considerations

Except at designated stream crossings, road building and other construction activities would avoid placing fill materials or structures in Riparian Areas that could potentially affect the ecological values of the stream. Factors such as stream class, channel stability, sideslope steepness, slope stability, resources dependent on these areas and standards, guidelines, and direction from Forest Plan are considered in determining the management of activities and width of Riparian Areas. Mitigation measures should be used to the optimum to insure minimum impact.

Practice: Surface Erosion Control at Facility Sites

Objective: To minimize the amount of erosion and sedimentation at developed sites.

Planning, Design and Construction Considerations

Lands developed for project facilities, parking areas, or construction lay down would be cleared of vegetation. Erosion control methods need to be implemented to stabilize the soil and to reduce the potential for of stream sedimentation. Some examples of erosion control methods that could be applied include: grass seed, jute mesh, silt fencing, tackifiers, hydromulch, paving or rocking of roads, water bars, cross drains, or retaining walls.

To control erosion and sedimentation, the natural drainage pattern of the area should not be changed. Sediment basins and sediment filters should be established to filter surface runoff. Diversion ditches and berms should be built to divert surface runoff around disturbed areas. Construction activities should be scheduled, where possible, to avoid periods of heavy precipitation or runoff.

APPENDIX H—IDENTIFIED MITIGATION FOR SENSITIVE AREAS CROSSED BY THE TRANSMISSION LINE ALTERNATIVES

THE DNRC has identified the following areas as sensitive areas where additional review by the DNRC and the KNF would take place during final design. These areas and measures apply to a particular alternative or are common to all alternatives. Those areas affected by the alternative selected by the Board of Natural Resources and Conservation would be incorporated into the Environmental Specifications as proposed for amending in Chapter 4 by the DNRC. The listed areas are locations where KNF and DNRC would concentrate monitoring efforts for the transmission line. The following discussion corresponds to those numbered areas on Figure H-1.

WILDLIFE

Miller Creek Centerline

Area 1. An elk security area would be crossed in the Miller Creek headwaters. Gates should be installed on access roads to restrict recreational use of the area. No through roads should be built in the security area to avoid encroachment into secure elk habitat. Construction should be timed to avoid extensive activity in this area during hunting season.

Area 2. The centerline would cross a big game winter range on lower Miller Creek. Construction activities on winter range should not be allowed between December 1 to March 31 unless written approval is given by the agencies, to avoid displacement of wintering deer, elk, and moose.

North Miller Creek Centerline

Area 3. An elk security area would be crossed in the North Miller Creek headwaters. Gates should be installed on access roads to restrict recreational use of the area. No through roads should be built in the security area to avoid encroachment into secure elk habitat. Construction should be timed to avoid extensive construction activity in this area during hunting season.

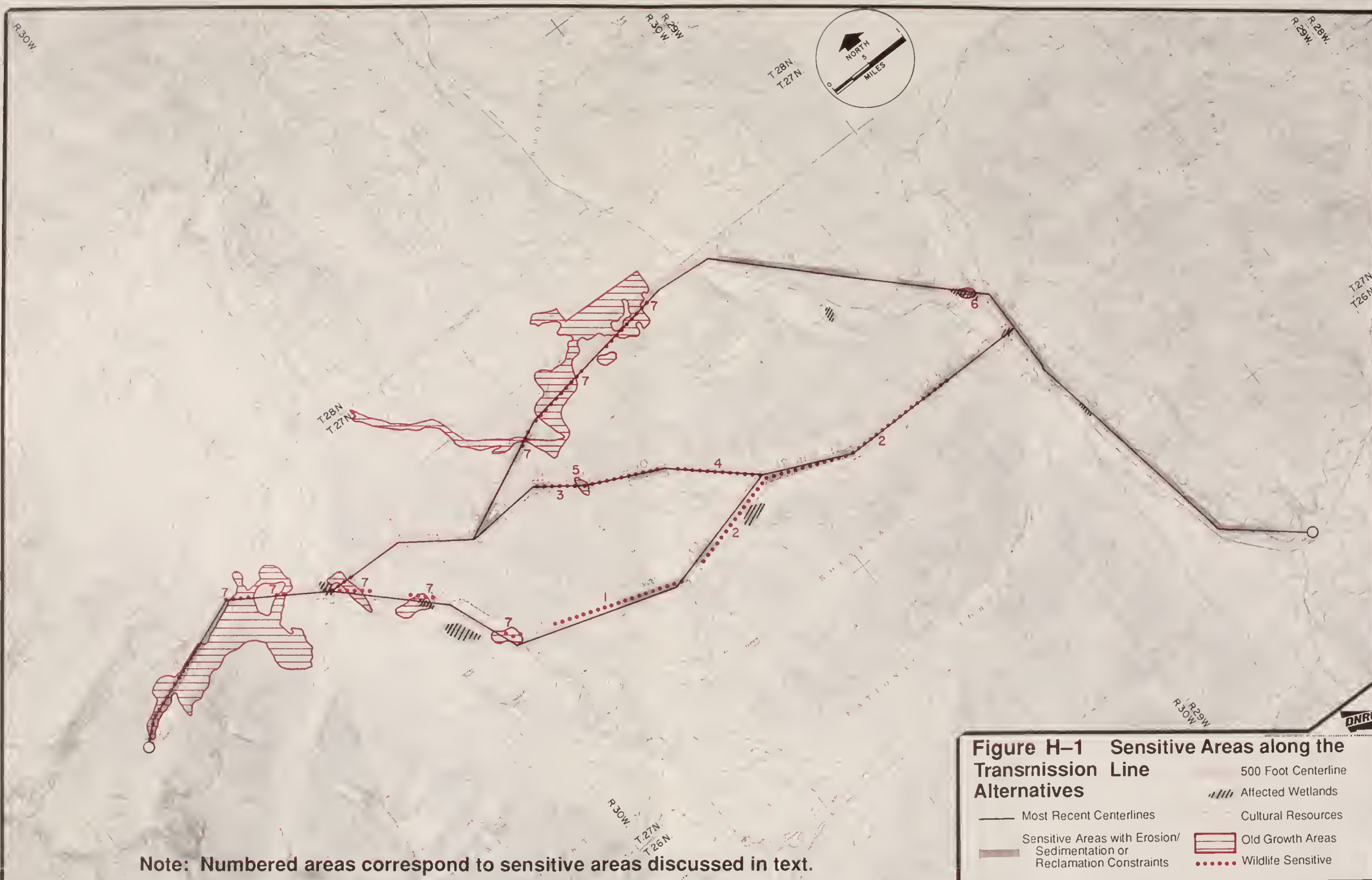

Figure H–1 Sensitive Areas along the Transmission Line Alternatives

Most Recent Centerlines

Sensitive Areas with Erosion/ Sedimentation or Reclamation Constraints

500 Foot Centerline

Affected Wetlands

Cultural Resources

Old Growth Areas

Wildlife Sensitive

Note: Numbered areas correspond to sensitive areas discussed in text.

Area 4. The centerline would cross a big game winter range on lower Miller Creek. Construction activities should not be allowed on winter range between December 1 to March 31 unless written approval is given by the agencies, to avoid displacement of wintering deer, elk, and moose.

Area 5. Structure locations on the ridge spur below PI-40 on the North Miller route (Alternative 5) should be placed to avoid the large trees in this area. The access road also should be designed to require no more than minimum clearing in these trees.

Swamp Creek Centerline

Area 6. Pole placement near the oxbow pond on the west bank of the Fisher River on the Swamp Creek route (Alternative 6) should avoid the need to remove any of the large trees south of the oxbow.

Sensitive Areas Common to All Centerlines

Because the existing old growth habitat is limited and difficult to replace, clearing in these areas should be minimized. In places of easy access, high maintenance line management may allow clearing a narrower right-of-way.

New access roads would be closed to vehicle travel. KNF may require additional spring timing restrictions on construction to minimize disturbance on grizzly bear using areas crossed by the line.

SOILS AND HYDROLOGY

All routes would cross sensitive areas with slopes exceeding 30 percent where road construction would cause greater disturbance than on level or gently rolling terrain. Intermittent streams also are crossed by all routes. Figure H-1 does not show all of these areas. The agencies and Noranda would review final road locations to determine how measures contained in Best Management Practices could be applied to minimize impacts based on site specific conditions.

The following discussion refers to the number code and shaded area on Figure H-1. Land types referred to are those described by Kuennen and Gerhardt (1984).

Sensitive Areas Common to All Centerlines

Area 1. Sedlak Park is a disturbed area that has been used in the past as a staging area for highway construction. Rerouting of Sedlak Creek should be done prior to substation construction and should take place during a period of low flow. The new channel should be dug prior to diverting the creek. The grade of new channel should approximate the grade of the present channel, and there should be no abrupt grade that would encourage headcutting of the channel. During construction of the substation, activity would be minimized adjacent to the new stream channel.

Area 2. The KNF has mapped this area as land type 252 (moderately dissected structural and fluvial breaklands on slopes greater than 60 percent), although inspection shows areas of erodible soils interspersed with glacial till, bedrock, and one landslide. Soil exposed by construction of about 1/4 mile of new road in this unit would tend to slump on steep cutbanks and would be difficult to revegetate. Given the steep slopes and close proximity to the Fisher River, sedimentation may occur when the road is constructed from PI-4 to PI-5. If structure PI-5 were located beside the haul road, impacts would be reduced. Prompt revegetation would be essential to reduce erosion and sedimentation.

Very steep sideslopes would be crossed by about 0.1 mile of new access road south of PI-4. Grades on this new road could exceed 30 percent. Bedrock and talus are exposed in an existing road cut below this area. Potential for soil erosion is high and would require additional review and approval when road locations are fully known to ensure sufficient reclamation measures are adopted. Revegetation standards should not apply to cut slopes where bedrock is exposed during construction.

Area 3. Soils in land type 112 (characterized by clayey lacustrine terraces on slopes of 0 to 25 percent) would be affected by construction of about

0.6 miles of new roads. Road grades are not excessive. These soils are erodible or have cut-and-fill slopes prone to failure, and revegetation is difficult. Potential for sediment delivery to streams is at least moderate. Seeding, mulching, and fertilization should be required to facilitate revegetation on cut slopes. In moist areas, willow, alder, and cottonwood shoots should be planted to help stabilize cut slopes.

Area 6. A wetland area is located at the proposed angle point, but a slight realignment (less than 500 feet) to the east would avoid placing the angle point in the wet area (Elliott, 1991). Final tower and road placement would be reviewed to ensure that wetland area is avoided. Stringing and tensioning activities would not be allowed in this area. Rock barriers or a gate should be placed to close this road after construction is complete. If wet areas restrict access during construction, steel mesh grates should be used to reduce rutting. If water is pumped from footing holes, it would not be directly discharged in streams or marshes. Sedimentation from discharged water could be reduced by pumping the water to a small temporary sediment retention pond or tank truck.

Area 7. Extensive road building and land leveling are proposed near Ramsey Creek. Mechanical measures should be taken to reduce sediment entering the creek. Reclamation should focus on prompt revegetation to minimize erosion and sedimentation. After the extent of disturbance is flagged, the agencies and Noranda would review the area to determine the additional mitigating measures that would be necessary to minimize erosion and sedimentation.

Area 15. This area should be spanned to avoid a wetland.

Additional Areas on the Miller Creek Centerline

Area 4. Very steep sideslopes on land type 355 (glacially scoured valley sideslopes with slopes from 20 to 50 percent) would be crossed by about 1/2 mile of new access roads. Road grades would vary from nearly level to over 20 percent. Reclamation measures in DNRC's Environmental Specifications would be used to avoid erosion and sedimentation. Revegetation standards should not apply to cut slopes if bedrock is exposed during construction.

Area 5. A wet area is located below a centerline span or immediately adjacent to it. The centerline should be realigned (less than 500 feet) to the east to avoid this area, or the structure at the north end of this area should be located on the uphill side of USFS Road 231. No construction activities should take place in the wet area without approval of the managing agency.

Area 12. Soils in land types 108 (lacustrine and alluvial materials on 0 to 15 percent slopes) and 112 (clayey lacustrine terraces on 0 to 25 percent slopes) would be affected by construction of about 0.6 miles of new roads. Road grades would vary from nearly level to about 10 percent. These soils are erodible or have cut-and-fill slopes prone to failure, and revegetation is difficult. Potential for sediment delivery to streams is at least moderate. Seeding, mulching, and fertilization should be required on cut slopes to facilitate revegetation. In moist areas, willow, alder, and cottonwood shoots should be planted to help stabilize cut slopes.

Area 16. A wetland, remnants of a river meander cut off by highway construction, is located downslope of the proposed line. The area would be spanned and no construction activities would take place in the wet area. Review of final design would identify any additional measures to avoid potential for sedimentation.

Additional Areas on the North Miller Creek Centerline

Area 10. About 1/3 mile of road would be located near a stream channel in land type 302 (warm and dry glaciated mountain slopes with southern exposure on slopes in the 20 to 60 percent range). Road grades would approach 30 percent on roads located 300 to 400 feet from the stream. Soils in this land

type are erodible and difficult to revegetate. Cut banks tend to slump. Given the moderately steep slopes, soil characteristics, and close proximity to a stream channel, sedimentation could result. Additional measures to control sediment would be determined by KNF, DNRC, and Noranda after the road location is flagged and field inspection occurs.

Area 11. This area, land type 360 (strongly scoured ridgetops with slopes from 15 to 35 percent), has been mapped by KNF as having poor reclamation potential. Where bedrock is encountered on cut slopes, it is not likely that revegetation could be accomplished. Therefore, the inspector may have to waive revegetation requirements in these locations.

Area 13. Soils in land type 108 (lacustrine and alluvial materials on slopes of 0-15 percent) in the lower portion of Miller Creek would be affected by construction of about 0.3 miles of new road. Road grades would vary from nearly level to about 10 percent. These soils are erodible, have slopes prone to failure if cut, or are difficult to revegetate. Potential for sediment delivery to streams is at least moderate. Seeding, mulching, and fertilization should be required on cut slopes to facilitate revegetation. In moist areas, willow, alder, and cottonwood shoots should be planted to help stabilize cut slopes.

Additional Areas on the Swamp Creek Centerline

Area 8. On steep slopes in land type 355 (glacially scoured valley sideslopes from 20 to 50 percent), road building should be minimized and existing roads and trails used where possible to avoid ground disturbance. Rocky material in this land type can limit revegetation.

Area 9. Wetlands could be encountered where the Swamp Creek route would cross the Fisher River valley. Existing roads and trails should be used where possible. If wet areas restrict construction access, steel matting should be used to minimize rutting and change in bottom contours. If water needs to be pumped from footing holes, it should not be discharged in streams, marshes, or oxbows. If shallow groundwater must be pumped from a footing hole, sedimentation could be reduced by pumping the water to a small temporary sediment retention pond.

Area 14. Soils in land types 108 (lacustrine and alluvial materials on 0 to 15 percent slopes) and 302 (warm, dry south-facing mountainsides with slopes from 20 to 60 percent) would be affected by a small amount of road construction (about 0.5 miles). Road grades would vary from nearly level to about 13 percent on one 600-foot long road spur. These soils are erodible or have slopes prone to failure if they are cut, and revegetation is difficult. Potential for sediment delivery to streams is at least moderate. Seeding, mulching, and fertilization should be required on cut slopes to facilitate revegetation. In moist areas, willow, alder, and cottonwood shoots should be planted to help stabilize cut slopes.

VISUAL

The following numbered areas correspond to those on Figure H-1 visually sensitive areas.

Visually sensitive areas 1, 2, 3, 5, 6, 8, and 10 have moderate or high potential for visual impact and would occur along the U.S. 2 corridor, near Forest Service recreation areas, and at crossings of USFS Road 231. In these areas, DNRC would review and approve clearing boundaries prior to clearing to ensure that right-of-way clearing is kept to the minimum necessary to meet requirements of the National Electric Safety Code. Proposed tower heights would be evaluated by DNRC, KNF, and Noranda where KNF land would be crossed to determine if increased structure height would decrease right-of-way clearing substantially. Where appropriate, this measure would be implemented by DNRC, KNF, and Noranda.

Also, DNRC and KNF would identify areas where tree planting within the right-of-way would effectively reduce visual impact for recreational users visiting the Libby Creek Recreation Gold Panning Area (visually sensitive area #3).

At visually sensitive areas 4 and 9, aeronautical safety markings could be required at the crossings of the Fisher River. If marked for aeronautical safety, care should be taken to minimize right-of-way clearing and retain existing vegetation that screens painted or lighted structures from residences or highway travelers.

At visually sensitive area 7, right-of-way clearing along a prominent ridgeline would be reviewed to balance clearing requirements and visual impacts. In this area, DNRC, KNF, and Noranda would develop site specific reclamation and revegetation measures to minimize potential for long-term visual impacts due to ground disturbance in areas having severe reclamation constraints (Figure 4-5 in the draft EIS). Care should be taken in building access roads to avoid unnecessary soil disturbance, because of the severe reclamation restraints.

VISUALLY SENSITIVE AREAS:

Common to all Routes

	1)	Structure 3 to Structure 9
	2)	PI-3A to PI-4
	3)	PI-13 to crossing of Libby Creek Recreation Gold Panning Area
Miller Creek Centerline		
	4)	PI-6 to Structure 24 (this segment is common to the Miller Creek and North Miller centerlines, if marked for aeronautical safety)
	5)	Structure 56 to PI-12
	6)	four crossings of USFS Road 231
North Miller Centerline		
	7)	3 structures both directions from PI-40C
	8)	PI-42 to PI-13 (this segment is common to the North Miller and Swamp Creek centerlines)
Swamp Creek Centerline		
	9)	PI-36 to Structure 28 (if marked for aeronautical safety)
	10)	base of slope near Structure 30 to Structure 32

[Structure locations based on profile of 9/22/90 submitted to DNRC]

THE following are material safety data sheets for reagents proposed for use in ore processing. The data sheets were developed by the American Cyanamid Company.

APPENDIX I—MATERIAL SAFETY DATA SHEETS

CYANAMID

MATERIAL SAFETY DATA

MSDS NO. 0628-03
CAS NO. 108-11-2
DATE: 05/08/89

PRODUCT IDENTIFICATION

PRODUCT NAME:	**AEROFROTH® 70 Frother**
SYNONYMS:	Methyl isobutyl carbinol; Methyl amyl alcohol; 4-methyl-2-pentanol
CHEMICAL FAMILY:	Alcohol
MOLECULAR FORMULA:	CH3CHOHCH2CH(CH3)2
MOLECULAR WGT.:	102

WARNING

WARNING! HARMFUL IF INHALED
CAUSES EYE AND SKIN IRRITATION
COMBUSTIBLE LIQUID AND VAPOR

OSHA REGULATED COMPONENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
Methyl isobutyl carbinol	000108-11-2	100	25 ppm (skin) 40 ppm STEL	OSHA/ACGIH

NFPA HAZARD RATING

Fire 2
Health 3 0 Reactivity
- Special

FIRE: Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
HEALTH: Materials which on short exposure could cause serious temporary or residual injury even though prompt medical treatment were given.
REACTIVITY: Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE:

Acute overexposure to methyl isobutyl carbinol vapor causes eye and mucous membrane irritation. The oral LD50 in rats is 2.6 g/kg in the rat, and the dermal LD50 in the rabbit is 3.6 g/kg. Five out of six rats died when exposed to 2000 ppm of methyl isobutyl carbinol vapor for four hours.

FIRST AID:

In case of skin contact, remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering.
In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention without delay.
If vapor of this material is inhaled, remove from exposure. Administer oxygen if there is difficulty in breathing. Give artificial respiration if person is not breathing and continue until normal breathing is established. Obtain medical attention without delay.

EXPOSURE CONTROL METHODS

Utilize a closed system process where feasible. Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure. Food, beverages, and tobacco products should not be carried, stored, or consumed where this material is in use. Before eating, drinking, or smoking,

wash face and hands with soap and water. Prevent eye and skin contact. Wear the special protective equipment specified below for operations where eye or skin contact can occur. Prevent contamination of skin or clothing when removing protective equipment. Provide eyewash fountain and safety shower in close proximity to points of potential exposure. Where exposures are below the PEL, no respiratory protection is required. Where exposures exceed the PEL, use respirator approved by NIOSH or full protective suit with air supply appropriate for the material and level of exposure. See "GUIDE TO INDUSTRIAL RESPIRATORY PROTECTION"(NIOSH). Special protective equipment - To prevent skin contact wear skin protection, such as impervious gloves, apron, workpants, long sleeve workshirt, or disposable coveralls. To prevent eye contact wear eye protection such as chemical splash proof goggles or face shield.

FIRE AND EXPLOSION HAZARD INFORMATION	FLASH POINT: METHOD:	102 F (38.9 C) Tag Closed Cup
	FLAMMABLE LIMITS (% BY VOL):	Lower - 1.0 Upper - 5.5
	AUTOIGNITION TEMP:	1081.4 F(583 C)
	DECOMPOSITION TEMP:	Not Available
	FIRE FIGHTING:	Use water spray, alcohol foam, carbon dioxide or dry chemical to extinguish fires. Water stream may be ineffective. Use water to keep containers cool. Wear self-contained positive pressure breathing apparatus and full firefighting protective clothing. See Exposure Control Methods for special protective clothing.

REACTIVITY DATA	STABILITY: CONDITIONS TO AVOID:	Stable None known
	POLYMERIZATION: CONDITIONS TO AVOID:	Will Not Occur None known
	INCOMPATIBLE MATERIALS:	Avoid strong acids or alkalies, strong oxidizing agents.
	HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or combustion may produce carbon monoxide and/or carbon dioxide.

PHYSICAL PROPERTIES	APPEARANCE AND ODOR:	Water-white liquid; mild odor
	BOILING POINT:	269.6 F(132 C)
	MELTING POINT:	-194 F(-90 C)
	VAPOR PRESSURE:	5 mm Hg @ 20 C
	SPECIFIC GRAVITY:	0.81@20C
	VAPOR DENSITY:	3.5
	% VOLATILE (BY VOL):	100%
	OCTANOL/H2O PARTITION COEF.:	Not Applicable
	pH:	Not Available
	SATURATION IN AIR (BY VOL):	0.66%
	EVAPORATION RATE:	0.33(Butyl acetate=1)
	SOLUBILITY IN WATER:	1.7% @ 20 C

SPILL OR LEAK PROCEDURES	STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Where exposure level is not known, wear NIOSH approved, positive pres sure, self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. In addition to the protective clothing/equipment in Exposure Control Methods, wear impervious boots. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water. Remove sources of ignition.
WASTE DISPOSAL	Disposal must be made in accordance with applicable governmental regulations.	
SPECIAL PRECAUTIONS	HANDLING AND STORAGE/OTHER:	Areas containing this material should have fire-safe practices and electrical equipment in accordance with Electrical and Fire Protection Codes (NFPA-30) governing Class II Combustible Liquids.
D.O.T. SHIPPING INFORMATION	PROPER SHIPPING NAME:	COMBUSTIBLE LIQUID, N.O.S.
	HAZARD CLASS:	COMBUSTIBLE LIQUID
	UN/NA:	UN1993
	D.O.T. HAZARDOUS SUBSTANCES:	(Reportable Quantity of Product) NONE
	D.O.T. LABEL REQUIRED:	None
TSCA INFORMATION	This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C.	
ENVIRONMENTAL INFORMATION	The following components are defined as toxic chemicals subject to reporting requirements of Section 313 of Title III and of 40 CFR 372 or subject to other EPA regulations.	

COMPONENT	CAS. NO.	%	SARA TITLE III TPQ (lbs.)	SARA TITLE III RQ (lbs.)	SARA TITLE III S313	RCRA	TSCA 12B
This product does not contain any components regulated under these sections of the EPA							

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA				
ACUTE (Y)	CHRONIC (N)	FIRE (Y)	REACTIVE (N)	PRESSURE (N)

Marvin A. Friedman, Ph.D.,Director of Toxicology and Product Safety

CYANAMID

MATERIAL SAFETY DATA

MSDS NO. 4921-02
DATE: 01/30/89

PRODUCT IDENTIFICATION

TRADE NAME:	**MAGNIFLOC® 491C Flocculant**
SYNONYMS:	None
CHEMICAL FAMILY:	Cationic polyacrylamide
MOLECULAR FORMULA:	Polymer
MOLECULAR WGT.:	Polymer

WARNING

IMPORTANT! SPILLS OF THIS PRODUCT ARE VERY SLIPPERY WHEN WET.

OSHA REGULATED COMPONENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
No Permissible Exposure Limits (PEL/TLV) have been established by OSHA or ACGIH.				

NFPA HAZARD RATING

Fire
1
Health 0 0 Reactivity
-
Special

FIRE: Material that must be preheated before ignition can occur.
HEALTH: Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.
REACTIVITY: Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE: A similar product had an acute oral (rat) and an acute dermal (rabbit) LD50 value of >2.5 g/kg and >10.0 g/kg, respectively. This similar product produced minimal eye irritation and no significant skin irritation during primary irritation studies in rabbits.

FIRST AID: In case of skin contact, wash affected areas of skin with soap and water.
In case of eye contact, immediately irrigate with plenty of water for 15 minutes.

EMERGENCY PHONE: 201/835-3100

AMERICAN CYANAMID COMPANY, 1 CYANAMID PLAZA, WAYNE, NEW JERSEY 07470

EXPOSURE CONTROL METHODS	Engineering controls are not usually necessary, if good hygiene practices are strictly followed. Before eating, drinking or smoking, wash face and hands thoroughly with soap and water. Wear the following as necessary to prevent skin contact: impervious gloves. For operations where eye or face contact can occur, wear chemical splash proof goggles.

FIRE AND EXPLOSION HAZARD INFORMATION	FLASH POINT:	Not Applicable
	FLAMMABLE LIMITS (% BY VOL):	Not Applicable
	AUTOIGNITION TEMP:	Not Available
	DECOMPOSITION TEMP:	Not Available
	FIRE FIGHTING:	As with many dusts, any dust that is generated may be explosive if mixed with air in critical proportions and in the presence of a source of ignition. Use water, carbon dioxide or dry chemical to extinguish fires. Wear self-contained, positive pressure breathing apparatus.
REACTIVITY DATA	STABILITY: CONDITIONS TO AVOID:	Stable None known
	POLYMERIZATION: CONDITIONS TO AVOID:	Will Not Occur None known
	INCOMPATIBLE MATERIALS:	Strong oxidizing agents.
	HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or combustion may produce carbon monoxide, carbon dioxide, ammonia, hydrogen chloride and/or oxides of nitrogen.
PHYSICAL PROPERTIES	APPEARANCE AND ODOR:	White to pale yellow granular solid
	BOILING POINT:	Not Applicable
	MELTING POINT:	Not Applicable
	VAPOR PRESSURE:	Not Applicable
	SPECIFIC GRAVITY:	Not Applicable
	VAPOR DENSITY:	Not Applicable
	% VOLATILE (BY VOL):	8-12(water)
	OCTANOL/H_2O PARTITION COEF.:	Not Applicable
	pH:	Not Applicable
	SATURATION IN AIR (BY VOL):	Not Available
	EVAPORATION RATE:	Not Applicable
	SOLUBILITY IN WATER:	Limited by viscosity

SPILL OR LEAK PROCEDURES	STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Spilled material becomes very slippery when wet. Sweep up spills and place in a waste disposal container. Flush the area throughly with water and scrub to remove residue. If slipperiness remains; apply more dry-sweeping compound. Do not flush large quantities of the material to sewer.
WASTE DISPOSAL	Disposal must be made in accordance with applicable governmental regulations.	
SPECIAL PRECAUTIONS	HANDLING AND STORAGE/OTHER:	Maintain good housekeeping to control dust accumulations. To avoid product degradation and equipment corrosion, do not use iron, copper or aluminum containers or equipment.
D.O.T. SHIPPING INFORMATION	PROPER SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED
	HAZARD CLASS:	NOT APPLICABLE
	UN/NA:	NOT APPLICABLE
	D.O.T. HAZARDOUS SUBSTANCES:	(Reportable Quantity of Product) NOT APPLICABLE
	D.O.T. LABEL REQUIRED:	NOT APPLICABLE
TSCA INFORMATION	This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C.	
ENVIRONMENTAL INFORMATION	The following components are defined as toxic chemicals subject to reporting requirements of Section 313 of Title III and of 40 CFR 372 or subject to other EPA regulations.	

COMPONENT	CAS. NO.	%	SARA TITLE III TPQ (lbs.)	SARA TITLE III RQ (lbs.)	SARA TITLE III S313	RCRA	TSCA 12B
This product does not contain any components regulated under these sections of the EPA							

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA
Not Applicable under SARA TITLE III

Marvin A. Friedman, Ph.D.,Director of Toxicology and Product Safety

This information is given without any warranty or representation. We do not assume any legal responsibility for same, nor do we give permission,inducement, or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation and verification. Before using any product read its label.

CYANAMID

MATERIAL SAFETY DATA

MSDS NO. 0290-04
DATE: 03/06/89

PRODUCT IDENTIFICATION

TRADE NAME:	**AERO® 350 Xanthate**
SYNONYMS:	Potassium Amyl Xanthate
CHEMICAL FAMILY:	Alkyl xanthate salt
MOLECULAR FORMULA:	n-C5H11OC(S)SK
MOLECULAR WGT.:	202.4

WARNING

WARNING! HARMFUL IF ABSORBED THROUGH SKIN
DUST IRRITATING
CAUSES EYE AND SKIN IRRITATION

OSHA REGULATED COMPONENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
Potassium hydroxide	001310-58-3	1.5	2 mg/M3 (ceiling)	OSHA/ACGIH
Isoamyl alcohol	000123-51-3	~0.5-3.0	100 ppm 125 ppm STEL	OSHA/ACGIH
Potassium sulfide	001312-73-8	~1	none	

NFPA HAZARD RATING

Fire
1
Health 2 1 Reactivity
-
Special

FIRE: Material that must be preheated before ignition can occur.
HEALTH: Materials which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.
REACTIVITY: Materials which in themselves are normally stable, but which can become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE: The acute oral (rat) LD50 value for this material is between 1.0 and 2.0 g/kg. The dermal (rabbit) LD50 value is estimated to be between 400 and 1000 mg/kg. The estimated 4 hour LC50 is 4511 ppm. Skin or eye contact with solutions of this product may cause moderate skin and eye irritation. Airborne dust may cause significant eye, skin or respiratory tract irritation. Carbon disulfide may be released as a trace contaminant or as a decomposition product of xanthates. Overexposure to carbon disulfide may produce eye, skin and respiratory tract irritation, skin sensitization, dizziness, headache, degeneration of peripheral nerves, manic depressive psychosis and cardiovascular disorders.

Toxicology information on regulated components of this product is as follows:

Acute overexposure to Potassium hydroxide or dusts causes severe respiratory irritation. A solution of Potassium hydroxide can produce irreversible damage to the eyes and skin.
Acute overexposure to isoamyl alcohol vapor may cause central nervous system depression and respiratory and eye irritation. The liquid is corrosive to the eye. The oral LD50 in rats is 5.0 g/kg, and the dermal LD50 in rabbits is 3.3 g/kg.
Potassium sulfide may cause eye and skin irritation. Under acidic conditions, potassium sulfide can decompose to produce flammable poisonous hydrogen sulfide gas.

FIRST AID:

In case of skin contact, remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering.
In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention if irritation persists.

EXPOSURE CONTROL METHODS

Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure. Food, beverages, and tobacco products should not be carried, stored, or consumed where this material is in use. Before eating, drinking, or smoking, wash face and hands with soap and water. Avoid skin contact. Protective clothing such as impervious gloves, apron, workpants, long sleeve work shirt, or disposable coveralls are recommended to prevent skin contact. For operations where eye or face contact can occur, wear eye protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure. Where exposures are below the Permissible Exposure Limit (PE respiratory protection is required. Where exposures exceed the PEL, use respirator approved by NIOSH for the material and level of exposure. See "GUIDE TO INDUSTRIAL RESPIRATORY PROTECTION" (NIOSH).

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT:	Not Applicable
FLAMMABLE LIMITS (% BY VOL):	Lower - 1.25; Upper - 50.0 (values for carbon disulfide)
AUTOIGNITION TEMP:	248 F (120 C) (value for carbon disulfide)
DECOMPOSITION TEMP:	491-536 F (255-280 C)
FIRE FIGHTING:	Use carbon dioxide, dry chemical or large quantities of water to extinguish fires. Heat causes decomposition to vapor of carbon disulfide. Wear self-contained, positive pressure breathing apparatus and full firefighting protective clothing. Solid xanthates are stable when kept cool and dry. However, exposure to heat and moisture can cause decomposition to flammable and explosive vapor of carbon disulfide. Since xanthates decompose in solution, even at room temperature, fire and explosion hazards can develop with aging. The moisture precautions do not apply to the product when diluted according to the Cyanamid Product Bulletin.

REACTIVITY DATA

STABILITY: CONDITIONS TO AVOID:	Unstable Exposure of the solid xanthate to heat or moisture and heating or aging of xanthate solutions.
POLYMERIZATION: CONDITIONS TO AVOID:	Will Not Occur None known
INCOMPATIBLE MATERIALS:	Strong acids, oxidizing agents, moisture.
HAZARDOUS DECOMPOSITION PRODUCTS:	Heat or moisture will liberate carbon disulfide. Thermal decomposition may produce carbon monoxide, carbon dioxide, sulfur oxides and/or carbon disulfide.

PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Yellow pellets or powder; slight disagreeable odor
BOILING POINT:	Not Applicable
MELTING POINT:	491-536 F(255-280 C)
VAPOR PRESSURE:	Not Applicable
SPECIFIC GRAVITY:	Not Available
VAPOR DENSITY:	Not Applicable
% VOLATILE (BY VOL):	~1.5
OCTANOL/H2O PARTITION COEF.:	Not Available
pH:	Not Applicable
SATURATION IN AIR (BY VOL):	Not Applicable
EVAPORATION RATE:	Not Applicable
SOLUBILITY IN WATER:	Appreciable

SPILL OR LEAK PROCEDURES	STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Where exposure level is not known, wear NIOSH approved, positive pressure, self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. Wear same protective clothing/equipment as in Exposure Control Methods. Sweep up spills and place in a waste disposal container. Flush area with water.
WASTE DISPOSAL	Disposal must be made in accordance with applicable governmental regulations.	
SPECIAL PRECAUTIONS	HANDLING AND STORAGE/OTHER:	Heating or overexposure to moisture of solid xanthates or heating or aging of xanthate solutions causes some decomposition to poisonous and flammable carbon disulfide. Maintain good housekeeping to control dust accumulations. Special precautions against fire and explosion must be observed in (1) pumping xanthate solutions, (2) draining mobile tanks, (3) cleaning mobile tanks, and (4) performing maintenance work on storage tanks and pipelines leading to and from tanks. Storage tanks should have certain design features for maximum safety, and the vapor space should be free of sources of ignition. Use nonsparking tools and do not smoke when opening drums of xanthate. Do not use xanthate products until you have read the "Safety Discussion" in the AERO Xanthate Handbook from this Company.
D.O.T. SHIPPING INFORMATION	PROPER SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED
	HAZARD CLASS:	NOT APPLICABLE
	UN/NA:	NOT APPLICABLE
	D.O.T. HAZARDOUS SUBSTANCES:	(Reportable Quantity of Product) NOT APPLICABLE
	D.O.T. LABEL REQUIRED:	NOT APPLICABLE
TSCA INFORMATION	This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C.	
ENVIRONMENTAL INFORMATION	The following components are defined as toxic chemicals subject to reporting requirements of Section 313 of Title III and of 40 CFR 372 or subject to other EPA regulations.	

COMPONENT	CAS. NO.	%	SARA TITLE III TPQ (lbs.)	SARA TITLE III RQ (lbs.)	SARA TITLE III S313	RCRA	TSCA 12B
Potassium hydroxide	001310-58-3	1.5	NONE	1000	NO	NONE	NO

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA				
ACUTE (Y)	CHRONIC (N)	FIRE (N)	REACTIVE (Y)	PRESSURE (N)

Marvin A. Friedman, Ph.D., Director of Toxicology and Product Safety

AERO* 350 Xanthate

AERO 350 xanthate - Potassium amyl xanthate in pellet form. This is the most powerful of the AERO xanthates. It is the most useful in operations where a strong non-selective collector is required.

A pelletized form offers the advantages of being non-dusting and free flowing, allowing for fast and safe product make down. Stability is also improved, because of the low surface area to weight ratio.

Typical Properties

Appearance	Yellow pellets
Solubility in Water 15°C	> 30%
Molecular Weight	202.4

Principal Uses

AERO 350 xanthate is widely used in the bulk flotation of all sulfide minerals where selectivity is not required. Because of its collecting power, AERO 350 xanthate also finds wide application in the flotation of oxide lead and copper minerals after sulfidization, in scavenger flotation and in the flotation of auriferous pyrite and/or pyrrhotite. Xanthates are generally not used in strong acid circuits due to their decomposition at low pH. Improved metallurgy can usually be obtained by using AERO 350 xanthate in combination with one or more of the AEROFLOAT® promoters.

Treatment Level

Suggested dosage rates are in the range of 0.05 to 0.50 lb/ton (25 to 250 grams/metric ton).

Application

It is recommended that AERO 350 xanthate be fed to the conditioner and/or flotation circuit as a 10-20% solution, using any conventional metering device such as a positive displacement pump, rotameter, or cup and disc feeder.

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CYANAMID

American Cyanamid Company
Industrial Products Division
Mining Chemicals
Wayne, New Jersey 07470

MCT-916

Caution

Flotation reagents should not be physically mixed with each other without first obtaining the assurance of the manufacturer or manufacturers that this would not present a safety hazard.

Storage & Handling

AERO 350 xanthate can be stored and handled in black iron, mild steel or stainless steel equipment. Copper and brass are not recommended for xanthate service.

Shipping

AERO 350 xanthate is shipped in 55 gal (208 liters) nonreturnable steel drums, net weight is 330 pounds (150 kg).

Technical Service

Effective mill management depends on using the best products with the latest technology in a totally balanced system. Cyanamid offers a complete line of products including collectors, frothers, flocculants, depressants and filtering aids. Your Cyanamid Sales Representative is prepared with information and backed with technical service to aid you in applying our products.

Important Notice

The information and statements herein are believed to be reliable, but are not to be construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE. Nothing herein is to be taken as permission, inducement or recommendation to practice any patented invention without a license.

CYANAMID

American Cyanamid Company
Industrial Products Division
Mining Chemicals
Wayne, New Jersey 07470

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STATEMENT OF FINANCIAL INTEREST

This Final EIS was prepared with assistance from IMS Inc. (IMS). Neither IMS, its officers, its employees, nor subcontractors that were used on this project have any interest, financial or otherwise, in the outcome of the proposed action or in Noranda Minerals Corporation or its parents or affiliates.

Thomas A. Colbert

Thomas A. Colbert
Vice President

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